Telephone Engineer

VOL. 31, No. 4 APRIL, 1927 CHICAGO

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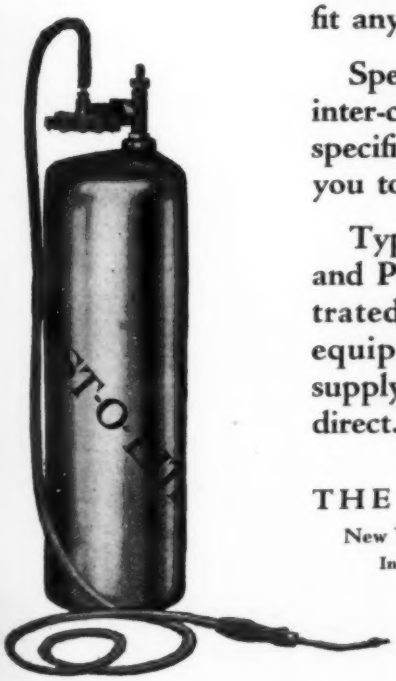

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Customers and Owners Guide Bell Financing

In recent weeks, the Wall Street stock market and financial writers in metropolitan papers have been giving some attention to the large accumulated surplus of the American Telephone and Telegraph company, and there have been rumors of a prospective "melon" for fortunate holders of that company's stock.

Recent stories from Washington relative to proposed legislation to increase taxes of corporations with large accumulations of surplus earnings has turned attention to such corporations in the expectation that they will distribute the surplus to stockholders to avoid such taxes.

At first sight, the surplus of one hundred and eighty-nine millions of dollars of the parent Bell Company at the end of 1926 would seem to offer the opportunity for a very large melon but when this amount is compared to the total issue of 1,112 millions of dollars in common stock it will be noted that the surplus represents only seventeen percent of the common stock. It is only twelve and one-half percent of the total capitalization of stocks and bonds. With dividend requirements of approximately one hundred million dollars per year, it will be seen that the company requires a surplus of considerable size.

From this analysis, it would seem that there is no possibility of any huge extra dividend for the stockholders and the present market price of the stock would indicate that whatever prospect of an extra there is has been pretty well discounted. The A. T. & T. Co. has treated its stockholders very generously with its current dividend rate of 9 percent and occasional rights to subscribe for stock at par.

It has found ways to reduce its annual surplus by reduction in license charges and by reduction in long-haul toll rates. Perhaps it will find other means of distributing its favors without disturbing the security of the stockholder's dividend possibilities. We have suggested the possibility of more generous treatment of connecting companies in the matter of toll commissions and we are informed that one or two of the subsidiary companies have taken steps along these lines.

In any case we may be certain that whatever action is taken will be guided by the joint welfare of the company, its stockholders and customers, rather than by the probable effect upon the stock market profits to be made by insiders.

"French Type" Phones Call for Higher Rate

The telephone business has not been subject to fads and changes in styles and designs as have many other businesses. One of its first experiences has come recently with the adoption by a portion of the public of the combination telephone fad. It was first taken up by the movies where the European type of telephone instrument was shown in many pictures. This popularized that style of telephone and certain dealers quick to profit from popular fancy began the sale of the so-called French-type instruments to subscribers of the telephone companies who had them connected in the place of the regular telephone instruments.

In order to protect their service from difficulties arising from use of inferior types of equipment, the telephone companies in some places have been forced to make stringent rules against attaching unauthorized instruments and have commenced to furnish the combination set. In the past, they have been very reluctant to furnish this type of instrument due to the fact that its general efficiency was lower than the standard types of instruments. Recent improvements have largely if not entirely overcome this difficulty but the combination instrument still is a more expensive instrument from a maintenance standpoint than the standard types.

Since the demand for this type of instrument is largely a matter of public fancy, it has been the custom with most companies to furnish the combination telephone only at an increase over the rate for service with standard instruments. This is as it should be, as the person who demands the special instruments should pay more than the subscriber

who is content to use the less fashionable but thoroughly reliable and economical standard types of wall or desk sets.

No Hope for Reviving Stone-Dead Companies

Our idea of absolute zero in the line of promotion activities among telephone companies, is an attempt to resuscitate a defunct farmer's mutual company which had expired from the infirmities of age complicated by a severe attack of sleet storm after years of combat against inadequate revenue, poor maintenance and no depreciation provision, to say nothing of the competition of a well managed commercial telephone company serving the same area.

Those of you who are telephone men will say "But certainly no telephone man would try to do such a thing." True, but not all promoters are telephone men and some of them are not even interested in giving telephone service. It now happens that telephone plants are popular things upon which to hang issues of bonds, stocks to sell to the public, and it is to be expected that outsiders will be attracted to the field in which there is apparently a profit to be made.

While no telephone man would attempt to work out a proposition like the one stated in the first paragraph of this editorial, the situation is not a fictitious one but is one that actually has occurred in one of the central states. At this writing it looks as if the deal would not go through, due to the good sense of the people in the community affected who refuse to become very much interested in the revival of a duplicate telephone service.

There has been some criticism of telephone association officials and of telephone publications on account of the stand they have taken in connection with some of the present activities in the financing of telephone properties. This journal has received its share, that is certain, and it is assumed that others who have thought along the same line have also. It is said that the discussions of the subject have tended to discourage public investment in telephone securities and that the best plan would be to leave the matter with as little publicity as possible.

Perhaps so, but we are not able to see it in that light. If promotions of the type we have mentioned—and there are others of similar character—go through, there is bound to be a considerable number of commercial failures and the result of a few receiverships will be much greater distrust of telephone securities than will be caused by anything we can say. The best service that can be given by those who have the real interest of the industry at heart is to do everything in their power to prevent issues of securities of doubtful value or no value at all being foisted upon an unsuspecting public.

How to Maintain a Plant Efficiently and Economically

A telephone exchange in one of our central states has something of a reputation among neighboring telephone men as being one of the best maintained plants in its territory. Anyone making even the most superficial inspection of the property would agree that its reputation is deserved. It is not a new plant but has a reasonable proportion of old and middle-aged elements. Even the oldest portions, however, give the impression of well-cared-for old age, rather than senile decrepitude.

On one occasion, a visitor, in conversation with the plant superintendent, remarked that the cost of maintaining the plant in such condition must be very large. The answer he received told the story of the condition of the plant and gave the causes for it in very few words. The plant superintendent replied: "We do not spend more on our maintenance than other companies of our size but it may be true that we get more for what we spend. The secret of the condition of our plant lies in two policies that are understood and applied by every member of our plant force. We never start a new job until the one before it is completed, and we never work on any part of the plant without leaving it in better condition than we found it."

It is not necessary to labor the point by discussion, for the answer shows that most of the factors that go into the production of a run-down plant have been eliminated. Any plant that never has been the victim of uncompleted, temporary or slipshod work is bound to be a good plant.

Television Brings New Vision of World Unity

As has been predicted, television has come and it is now possible not only to hear but to see at a distance. With this, it would seem that the problem of distance has been completely conquered. Man may now bridge the ocean with his voice, may transmit photographic representations and the written word and may even see a visual image of a distant person or scene at the time it is pictured. He may travel at speeds in excess of anything heretofore dreamed of. Truly the world is getting to be a small place and nations and races are getting to be close neighbors. It is to be hoped that friendliness will increase upon better acquaintance.

Uniform Toll Schedule Way Out of Confusion

The action of the Wisconsin Railroad Commission in permitting Independent companies to file the same schedule of toll rates as the Wisconsin (Bell) Tel. Co. is to be commended to other commissions. Much confusion arises in other states where different schedules are maintained and where rates between certain points will vary with the routing.

Thermal and Field Measuring Instruments*

By F. J. DOMMERQUE
Fellow A. I. E. E.

54. Hot Wire Instruments

Currents are often measured by means of instruments, which depend on the *heating* of a wire. Such instruments are therefore classified as "thermal" instruments, which comprise thermal amperemeters, or briefly ammeters, for the measurement of electric currents and thermal voltmeters for the measurement of voltages.

The heat developed in the wire, when a current passes through it, is proportional to the power expended in overcoming the resistance of the wire. If the resistance remains constant, the value of the current varies directly as a difference of potential; by doubling the difference of potential, the current is also doubled, and the heat developed then varies as the square of the difference of potential. Therefore an instrument may be designed which will consist of a wire of high resistance and which is heated by the passage of the current whose e.m.f. it is desired to find. The amount of elongation of the wire can by proper apparatus be made to indicate the voltage of the circuit.

One of the earliest hot wire voltmeters was the Carden voltmeter. It employs a very fine platinum-silver wire. The wire is stretched under the action of a spring and by suitable mechanism is connected with a registering pointer. When applied to a circuit, a small fraction of the current passes through the fine wire, and being transformed into heat, expands it. The movement of the pointer or needle indicates the amount of expansion upon a dial; by proper calibration the figures on the dial can be made to read in volts. The instrument is perfectly dead-beat and absolutely insensitive to all magnetic fields.

A hot wire ammeter is advantageously used for the measurement of alternating currents of high frequency and potential, particularly of currents of radio frequency. A simple form of hot wire ammeter is a U-shaped glass tube of fine bore with a bulb blown on at each end. A fine platinum wire is sealed crosswise in the bulb. The tube is filled with colored alcohol, which normally stands about half way up both legs. When a current passes through the platinum wire, the heat expands the air in the bulb and the alcohol in the straight leg will rise, indicating on a calibrated scale, attached behind the leg, the current passing through the wire.

In a commercial hot wire ammeter, such as manufactured for wireless work, a platenoid wire or bunch of twisted wires is stretched over a base of glass, marble or slate. At the middle of this hot wire a silk thread or another platenoid wire is fastened, the other end of which is run to the tail end of a needle or pointer. Normally the needle stands at the zero point of a dial, kept there by its own weight; in this position it keeps the thread taut. When the current passes through the hot wire, the latter expands and the slack in the thread will permit the needle to fall by its own weight. After the current is cut off, the wire will tighten the thread and draw the needle point to zero again.

If oscillating currents are passed through the hot wire, the readings on the scale will give the root-mean-square values of these oscillations. What the expression "root-mean-square" means will be explained when we take up alternating currents. Often we have to anticipate subjects, in order to have the subject under discussion complete, but that cannot be helped; all will come right in the end.

There are various forms and modifications of this type of hot wire ammeter on the market. One form employs a needle mounted on a light sheet of aluminum which is able to rotate, being carried on a spindle. The spindle itself carries a pulley over which the silk thread passes, the end of the thread in this case being fastened to a steel spring. When the thread slackens, the steel spring will take up the slack and thereby rotate the pulley and also the needle.

55. Thermocouple Instruments and Thermoelectric Currents

A thermocouple instrument is a type of hot wire ammeter which makes use of the *Peltier effect*. To explain the Peltier effect we have to get first an understanding of thermoelectric currents. If in a closed circuit of two metals the two junctions of the metals are at different temperatures an electric current will flow round the circuit. The direction of the current is such that the current flows from a metal in the following row to any of the metals preceding it:

+ Antimony, arsenic, iron, steel, cadmium, tungsten, zinc, silver, gold, molybdenum, tin, lead, mercury, manganese, copper, platinum, palladium, cobalt, nickel, bismuth —.

When a current flows across the junction of two metals in one direction heat is absorbed, while if it flows in the opposite direction, heat is liberated. The heat liberated or absorbed is proportional to the quantity of electricity which crosses the junction. The amount of heat liberated or absorbed when unit charge of electricity crosses the junction is called the Peltier effect at the temperature of the junction, after Peltier, its discoverer.

In a thermocouple instrument the heat of the hot wire acts upon the junction of two metals, as for instance bismuth and iron, which junction is designated a thermo-junction. A voltmeter or galvanometer connected to the thermo-junction will give readings, which are very nearly proportional to the square of the current passing through the hot wire.

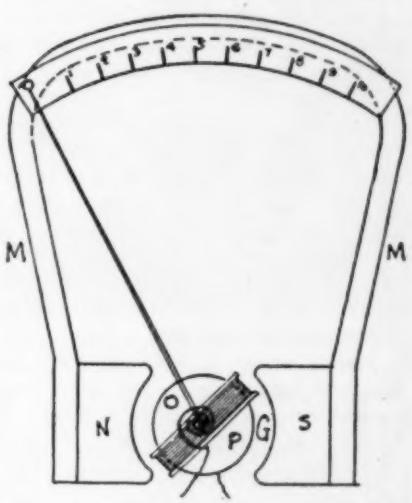


Fig. 75

A thermo-galvanometer has a moving coil containing a thermocouple, the moving coil being suspended directly above the heating coil.

56. Voltmeter and Ammeter Methods

The most desirable measuring instruments for field work consist of a powerful horseshoe magnet M in Fig. 75, carrying two enlarged pole pieces N and S. Between the polar extensions a fine wire coil, P, is delicately pivoted upon jewel bearings not shown in the figure. To this movable coil P is attached the

*Thirteenth article on Telephone Mathematics and Physics.

pointer or index, which plays over a graduated scale. A cylindrical core, O, of soft iron is introduced between the poles N and S to provide a good magnetic path for the lines of force. We know that a coil of wire carrying an electric current when placed between the poles of a magnet, will tend to set itself at right angles to the lines of force. In order to make a measuring instrument it is necessary that this tendency to turn be opposed by some well-known graduated counterforce. In measuring instruments this is accomplished by introducing two spiral springs, fastened to the ends of the coil above and below, close to the bearings. When no current flows in the instrument these springs will keep the coil at a certain zero position, from which it will be deflected in proportion to the current through the coil. The pointer may be arranged to move over an appropriately graduated scale, giving indications which, by proper calibration, will be of great precision.

The best known instruments of this kind, as for instance the Weston instruments, are made to cover every practical range of capacity, and are designed to be used either as voltmeters, ammeters or also as wattmeters. They are arranged to be used either on direct or alternating current and are perfectly dead-beat.

To measure a resistance by means of a voltmeter, the resistance to be measured is connected in series with a known resistance and a battery or other source of current. The voltmeter is first connected around the known resistance, which may be designated as r. Suppose under these circumstances the reading of the voltmeter to be V volts. After this reading is obtained, the voltmeter is connected in a similar manner around the resistance R to be measured. In the latter case suppose the reading on the voltmeter to be V^1 volts, then $V : V^1 = R : r$ and $R = \frac{rV}{V^1}$.

By this method the measurement made by the voltmeter is the fall of potential through each resistance. As the electromotive force is supposed to be constant, the fall is directly proportional to the resistance.

A modification of the preceding method may be made, when no convenient known resistance is at hand, by using in place of the known resistance an ammeter, which is placed in the circuit with battery and resistance R to be measured, in series. In this method the current I flowing in the circuit, is given by the reading of the ammeter, while the fall of potential E through the unknown resistance R is given by the voltmeter. Thus R may be readily calculated by Ohm's formula $R = \frac{E}{I}$.

Where the resistance to be measured is very small and consequently the fall of potential is very small, a milli-voltmeter must be substituted for the voltmeter in order to obtain readings of sufficient accuracy.

57. Battery Resistance

The internal resistance of a battery can be measured with a voltmeter. Connect the voltmeter in series with the battery as shown in Fig. 76. Again r is a suitable known resistance, which can be cut in and out by an appropriate key. When the key is open, the reading on the voltmeter Vm indicates the potential of the battery. Upon closing the key the voltmeter indicates the difference in potential "e" existing between the ends of the known resistance r. Suppose the battery to have an electromotive force E; then the resistance R of the battery is found as $R = r\frac{E - e}{e}$.

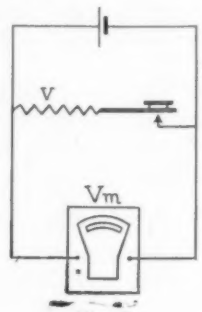


Fig. 76

58. Insulation Resistance

The insulation resistance, that is, the resistance offered by leaks or grounds on an open wire or cable line, can be determined quantitatively by the galvanometer. When it is desired to determine only whether or not the insulation resistance of any particular wire is high or not, a telephone receiver and battery will answer the purpose. At the end of the cable to be tested all the wires are stripped of their insulation and connected togther and also with the sheath, except the wire under test. To the sheath one side of a battery of 3 or 4 cells is attached, the other side of the battery being connected to a telephone receiver. A piece of well insulated wire is then attached to the other receiver binding post, while the free end of this wire is touched to the cable conductor to be tested. This conductor becomes charged immediately, which causes a click to be heard in the receiver. If the insulation resistance of the conductor is perfect, the electric charge will be retained and a break and contact made after a few seconds duration of the first contact will not give any further sound in the receiver. If, however, the insulation resistance is faulty, more clicks will be heard as the wire is touched to the cable conductor. Roughly it can be assumed that with intervals of time between break and make of one second with a battery of one volt no click means a resistance of at least 50 megohms. When more battery is used this number will increase about in proportion to the number of cells. Care should be taken not to mistake the sounds produced by induction for those produced by leaks. On very long cables the charge sometimes causes a second but faint click.

It is customary to give the insulation resistance in megohms per mile or per kilometer. 1 megohm = 1,000,000 ohms.

To make a quantative test of insulation resistance, the previously described testing set (Fig. 69 and 70, supplemented by the skeleton diagram, Fig. 77) may be used. It is necessary first to determine the galvanometer constant, that is, the number of scale divisions deflection produced by a current from one or more cells flowing through one megohm. The same number of cells must be used when taking the galvanometer constant and when measuring the unknown insulation. First set BA switch to INS. Then open loop switch WB and ML (Fig. 70) and switch in 10,000 ohms in the rheostat. Set bridge arm A at INF and bridge arm B at 0. Shortcircuit line posts with a piece of wire. Press the keys BA and GA and note deflection of the galvanometer. The galvonometer constant is then $C = \frac{D \times R}{S \times N}$, where D = galvanometer deflection, N = number of cells, R = resistance in rheostate in fractions of megohm — 0.01 in this case, S = value of shunt used.

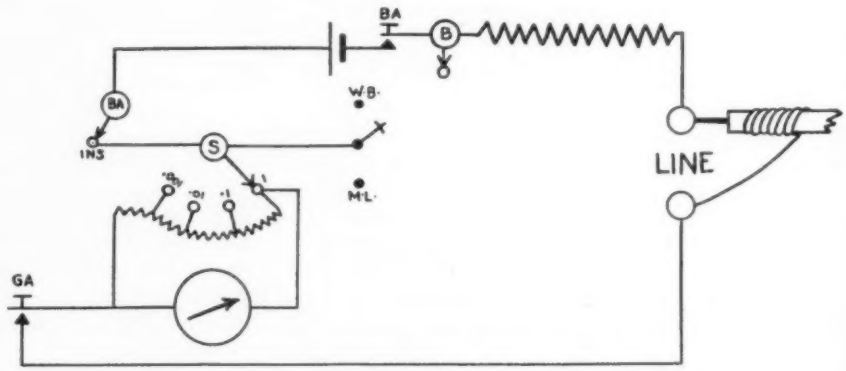


Fig. 77

As an example we may determine the galvanometer constant with 4 cells of battery. Assuming by following the above given instruction a deflection of 4 divisions is observed, then the constant C will be $C = \frac{4 \times 0.01}{0.01 \times 4} = 1$ megohm.

To measure the insulation resistance, proceed as follows: First remove the shortcircuit from the lineposts; then connect the cable conductor to the upper "LINE" post and ground connection to the lower "LINE" post. Close the keys BA and GA and note the galvanometer deflection; if small, more battery should be used. If insulation is low it may be necessary to use 0.001 shunt, or if insulation is high, the 1 shunt may be required. The reason of the foregoing shunt settings is obvious. If the insulation is low, the testing current permitted to flow through the galvanometer by reason of the faulty insulation will be large, hence the galvanometer must be shunted, whereas nearly perfect insulation will allow but little "escape" and in order to give a readable deflection all the current must be made to pass through the galvanometer; hence shunt 1 is used. Thus when beginning a test always place shunt at 0.001 so as to protect the galvanometer in the event of a low insulation. If the deflection is not sufficient, turn the shunt switch S to 0.01 and 0.1 and 1. The insulation I under test is $I = \frac{N \times C \times S}{D}$, where I = unknown insulation, C = galvanometer constant, S = value of shunt used, N = number of cells.

For example with 4 cells of battery the deflection was 1 division using 1 shunt. Then $I = \frac{4 \times 1 \times 1}{1} = 4$ megohms.

If a readable deflection can not be obtained with the battery, then an outside e.m.f must be connected to posts BA, connecting polarity as indicated in Fig. 70. In this event the galvanometer constant should be taken with this outside e.m.f.

It is best to make the insulation test with 10,000 ohms in series, so as to protect the battery in case of a very low insulation. Where great accuracy is required, the 0.01 megohm can be subtracted from the calculated absolute insulation.

If the insulation resistance per mile is required, use the formula below which is the same as the one above, except L or the length of the cable in the denominator.

$$I = \frac{N \times C \times S \times L}{D \times 5280}.$$

59. Murray Loop Test

Although description of practical testing is outside of the sphere of this articles, brief mention may be made of the well-known Murray and Varley loop test in order to round out the subject. Again the reader is referred for more elaborate and more detailed dissertation to the papers of Mr. Kerr Higgins on testing.

Using Fig. 70, connect faulty conductor to upper "LINE" post and another good conductor to lower "LINE" post, the faulty and good conductors being joined at the far end. Measure resistance of entire loop and call it R. Then connect post marked GR to ground or, if fault is a cross, connect the wire crossed with the faulty wires. Set BA switch to GR, throw knife switch to M. L., set B on zero, A on 1000, and vary rheostat until balance is obtained. Designating the resistance of conductor from upper "LINE" post to fault by X, it will be $X = \frac{R \times r}{A + R}$, where R = resistance in rheostat, r = total resistance of loop and A = resistance in A arm.

60. Varley Loop Test

Connect faulty and good conductors as explained for Murray loop test and measure loop resistance as in regular resistance test having switches at W. B. Connect GR post as explained above and place BA switch at GR. Small knife switch to remain at W. B. Place resistances in A and B. Then $X = \frac{B \times r - A \times R}{A + B}$, or if A and B are equal, $X = \frac{r - R}{2}$. R, r and A have the same designation as above and B = resistance in B arm.

If it is intended to use an outside galvanometer with the bridge, its terminals should be connected to posts marked GA on top of Fig. 70 and the GA switch should be thrown to side marked "OUT."

If an outside battery is to be used it should be connected to the BA posts after flexible cord tips have been removed.

CHECK YOUR EXPENSES BY THIS

An analysis of the reports of eighteen of class A independent telephone companies in the State of Indiana to the Public Service Commission for the year 1925 shows that out of their gross revenue they spent their money as follows:

Maintenance and Depreciation	32.26%
Traffic	20.27%
Commercial	6.16%
General and Miscellaneous	8.07%
Taxes and Uncollectibles	9.03%
Rents, Interest and Dividends	24.21%

—Indiana Telephone Bulletin.

C. W. Holtzer, Chairman of the Holtzer-Cabot Board, Dies

Boston, Mass.—Charles W. Holtzer, chairman of the board of the Holtzer-Cabot Electric Co., died here March 31 after an illness of several months. Mr. Holtzer, who came to the United States from Germany in 1866, became interested in telephony early in the history of the industry and shortly after establishing his own electrical business in 1874 constructed and operated the first telephone exchange outside of Boston.

He always maintained a keen interest in telephony and was a factor in developing telephones for war use on battleships and in the field. He took an early part in the development of telephone power

The Late C. W. Holtzer

plants and saw to it that his company played an important part in this work. His company spread out into the production of motors, signalling devices and other electrical equipment until the fiftieth year of its history, 1925, found it internationally known as a leading electrical establishment.

Mr. Holtzer was endowed with a personality that endeared him to his organization's employes clear down the line to the newest of its workers. Despite the crowded condition of his working calendar he always found time to take a personal interest in the activities of the employes and rejoiced to see a lengthy list of able veteran employes on the Holtzer-Cabot roster.

Class A Companies to Meet Chicago May 12-14

Chicago, Ill.—Annual conference of the Class A companies of the United States Independent Telephone Association will be held at the Edgewater Beach Hotel, Chicago, May 12, 13, 14.

Traffic Data for New Automatic Exchanges

By J. KRUITHOF

While there is such a vast amount of literature, both in books and in articles in the various mathematical and telephone papers, which deals with methods for calculating the number of switches required in an automatic exchange, there is very little information existing on methods for estimating the traffic needed as a basis for these calculations. Correct knowledge of the traffic a certain exchange must be able to handle is of primary importance to any switch calculation, as even the most accurate switch calculation based upon wrong traffic data will certainly lead to an over or under switched exchange.

This disparity is due to the fact that the responsibility for the switch calculations is shared by the operating concern of the future automatic exchange and the manufacturer of this exchange. The telephone corporation supplies with its invitation for bids the traffic information and the manufacturer bids on the necessary number of switches which he guarantees to give a certain grade of service, provided that the traffic really is as submitted to him.

In practice this method of working has resulted in very abstract and minute probability calculations on the part of the manufacturers and interested mathematicians, and on the other hand of very approximate information on traffic data supplied by engineers of operating organization. The latter are faced with the difficulty of estimating something for which there is very often little information in existence to base their estimates upon, and a manufacturer must be able to defend calculations which prove that the amount of switches he bids on is sufficient to carry the given traffic, which amount of switches, of course, for competitive and economic reasons he wishes to keep as low as possible.

An engineer in charge of preparing projects for automatic exchanges is very often faced with great difficulties, and in general a wide experience is needed to solve traffic problems which arise on account of the traffic information he receives being incorrect or incomplete.

Principal Traffic Data

The present article deals with the principal traffic data which are generally needed for the preparation of a project for an automatic exchange, and it considers the method by which actual traffic data may be used as a basis to estimate the traffic data which will be imposed on the competitive manufacturers for the calculation of the exchange. These principal traffic data are:

(a) Calling rate.
(b) Holding time of connection.
(c) Trunked traffic.

The originating traffic per line per busy hour, in short the calling rate, represents the number of times an average subscriber calls during the busiest hour of the day. The calling rate is a quantity which varies during the week and very often it may show considerable variations during the year. These fluctuations largely depend on economical reasons, and as a matter of fact the highest calling rate will be experienced during the "season"; that is, during the time that the special business of a place culminates. A few examples of this type of place are: Holiday resorts, agricultural centers, etc.

Many towns do not have a dominating trade, but still it will always be observed that the exchange traffic shows a maximum and minimum at certain times of the year, and that for a certain town these periods are typical and recur every year.

From the above it will be clear that a grave error is made when the engineer in charge of making the necessary traffic observations for a new automatic exchange, merely assumes the calling rate to be the average of the calling rate observed in the existing exchange during the course of a few weeks or even days. It will be evident that at least for a whole year—if required at fixed intervals—traffic observations must be made.

As, however, in most cases the time for collecting data for a new exchange is rather short (traffic observations are very often considered unnecessary until the moment they are badly needed) it must be left to the knowledge the traffic engineer possesses of local circumstances when making an estimate, as to how far the average calling rate will approximately hold good for the whole year.

For a case where complete data for one year is available and the calling rate shows the usual fluctuations it is not advisable to simply take the average for this year, as this would mean that the new exchange would be under-rated for approximately 50 per cent of the busy hours. In such a case the calling rate for the planned exchange is then generally so assumed that for only 5 to 10 per cent of the busy hours the exchange is under-calculated. This percentage does not include Sundays, which are generally not considered for traffic observations.

The careful reader, however, may have certain objections to this method of arriving at the calling rate for which an exchange is to be calculated. He will first observe that this calling rate may be correct as far as the subscribers connected to the old exchange are concerned, who will become automatic after the new exchange is cut over, but that the new subscribers may have interests completely different from those of the subscribers observed and that consequently the assumed calling rate will be incorrect.

Such a case may occur when it can be safely assumed that the majority of the new subscribers will, for instance, be residential rather than business firms of whom the old subscribers may principally consist. The latter class of subscribers will generally have a higher calling rate than the former.

As a further example he may observe that by the increase in the total number of subscribers the calling rate will accordingly go up, as the possibility of reaching a certain person by telephone is increased. There is certainly some truth in this suggestion, especially for the case where the number of telephone lines available does not meet the demand for telephone service on account of bad exploitation on the part of the telephone authorities, lack of capital or other reasons. In connection with this it must be observed that the better service rendered by an automatic exchange will also stimulate an increased use of the telephone.

On the other hand there are certain reasons which will tend to decrease the average calling rate. The more telephone lines, say per 100 inhabitants, there are in operation in a certain town, the lower the calling rate for the new subscribers will be, as it is a fact that the last subscribers who demand telephone connections are those for whom such connections are not absolutely necessary, but more or less a luxury.

Service Controls

Further, when a corporation decides to introduce full automatic telephone service they very often also decide at the same time to introduce measured service. The introduction of service meters has a strong tendency to immediately lower the calling rate and therefore its influence

must be considered when estimating this figure for a new exchange.

It is the experience of the author that only in very rare cases extensions to existing exchanges are required on account of increased traffic, from which it appears that the assumed calling rate is generally over-estimated. More often it happens that the need for telephone service, i. e., the number of lines, is under rated. Many exchanges have already been waiting for an extension before one line of the original installation has been cut over. It is true that in some cases this may be due to budget reasons, but nevertheless the fact remains.

To assume a low figure for the calling rate is, for the case where the number of lines in a new exchange is not too closely estimated, not so dangerous as it is thought to be. It is more preferable to estimate the calling rate for a new exchange as low as possible, but to fix the number of subscribers' lines liberally, rather than to be liberal with the number of calls per line per busy hour and to save on the line equipment.

The different in price, e. g., between a 2200 line exchange with a busy hour calling rate of, say, one per line and a 2000 line exchange with a calling rate of 1.1, will not be so great, as both exchanges will be calculated for a total traffic of $2200 \times 1 = 2000 \times 1.1$ calls per busy hour. The quality of the service which both exchanges will render to an initial number of, say, 1200 lines will be the same even if this number should increase to 2000, provided that care is taken that these lines are equally distributed over the various groups in which the switches are split. During the period that the number of lines connected to the exchange increases from 1200 to 2000 the telephone corporation has sufficient time to make the necessary traffic studies for verifying the calling rate on which the switch calculations were based. Should it then appear that this figure was under-estimated, there is sufficient time left to order the necessary additional equipment.

There will further be another safety margin in that the line equipment of the exchange will practically never be fully connected up to subscribers' stations, on account of the constant changing number of subscribers. A subscriber's number which has been given up cannot for various reasons be immediately assigned to a new subscriber. It would therefore even be possible to assume a 5 per cent lower calling rate when it may be estimated that by the changing referred to the exchange will never reach more than 95 per cent of its line equipment.

It may serve the purpose to state here that the calling rate generally varies between 0.8 and 1.3. In very rare cases it may reach 2, but a figure so high is in practice rarely met with and then only in purely business centers. As the percentage of busy connections depends on the number of calls per line per busy hour, a high calling rate means a high percentage of busy connections, i. e., calls for which the exchange equipment is used but from which no revenue is received.

Many administrations therefore insert in their contracts with subscribers the stipulation that a new line is to be taken in a case where the total number of calls per line per year exceeds, say, 8,000, which figure corresponds with approximately 3 calls per busy hour.

Holding Time a Factor

The second important traffic figure required for calculating an automatic exchange is the average holding time of a connection. The holding time is of the same importance as the calling rate, for the reason that the calculation of the various numbers of switches in the exchange is based on the product of the calling rate and the average holding time. The figure for the holding time must, therefore, be as carefully considered and estimated as the number of calls per subscriber's line per busy hour.

In general the traffic engineer will again base the average holding time to be assumed for the new exchange on observations made on the existing exchange. He will fix this figure as low as possible, but still sufficiently high to avoid any risks.

As the product of the calling rate and average holding time only matters in the determination of the various numbers of switches it would seem to be the best solution not to observe these quantities separately but in combination, i. e., not to express the observed originating traffic in two figures, one for the calling rate and one for the holding time, but to express the traffic in traffic units (T. U.), call minutes or E. H. H. C.'s (= equated busy hour calls, i. e., calls reduced to a two-minute holding time) as the custom may be.

To apply this in practice, however, meets with certain difficulties. As already stated above, the calling rate is directly observed by counting the calls on the "A" positions, whereas a figure for the holding time is obtained by observing only a certain number of actual calls. On account of this method of observing the average holding time of a connection it will be clear that only a comparatively small number of calls are observed so that the result will be rather inaccurate.

When the existing exchange is of the C. B. type, the best method for observing the calling rate and holding time seems to be to use an ampere hour meter and arrange the feeding for a certain relay in all the cord circuits in such a manner that the current consumed passes through this meter. The cord circuit relay to be chosen must receive current from the moment the connection is established and its circuit must have a constant resistance. Attention must also be paid to a constant value of the exchange potential and any sudden change must be noted.

Assuming that for a certain exchange the ampere hour meter indicates for one busy hour a consumption of 10 A. H. that the resistance of the chosen circuit amounts to 300 ohms and that the voltage of the battery is 24 volts, then the traffic which passed through the exchange will be:

$$\frac{10 \times 300 \times 30}{24} = 3750 \text{ E. B. H. C.}$$

(or 125 T. U.)

Assuming that the number of calls is, say, 3,000, the holding time observed will be:

$$\frac{3750}{3000} \times 120 = 150 \text{ seconds.}$$

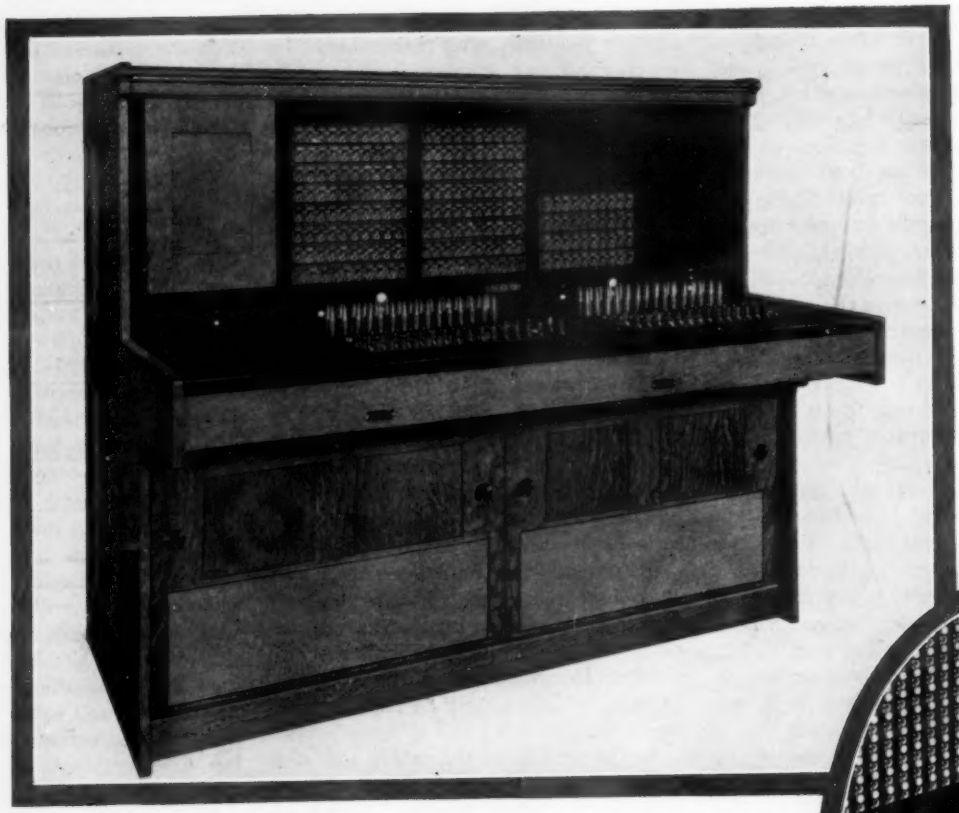
This holding time includes the ringing and conversation time, but not the time required for setting up the connection. For full automatic exchanges, however, the total holding time must also include the switching time, i. e., the time from the moment the subscriber lifts the receiver from the hook until the moment the wanted subscriber's line is reached. As the average switching time is not the same for the various automatic systems it would be well to leave it to the competitive manufacturers to add the switching time required for their respective systems.

Care also should be taken not to include the time required for the release of the connection, as this time may reach a value which must not be neglected. In full automatic exchange systems the release of all switches engaged in a connection is performed in less than one second, whereas during the busy hour in manual exchanges the operators may be so busy that even after both supervisory lamps are lighted, for some time the plugs are left in the subscribers' jacks. In special cases it may even be decided to place, during the time the observations are made, an additional operator behind, say, every six "A" operators, with the sole function to assist these operators in releasing cord circuits.

If the calling rate is decreased by the introduction of service meters, the influence of measured service on the holding time will be the contrary, as the latter will be increased. Its influence, therefore, will be that the subscribers will call less frequently, but once a connection is obtained, they will be inclined to make a prolonged use of it. It remains, however, an open question what its influence will be on the real traffic, e. g., on the total number of call minutes per subscriber per busy hour (or on the traffic expressed in E. B. H. C.).

Exchange Traffic

When the new exchange will have to work in conjunction with a second ex-



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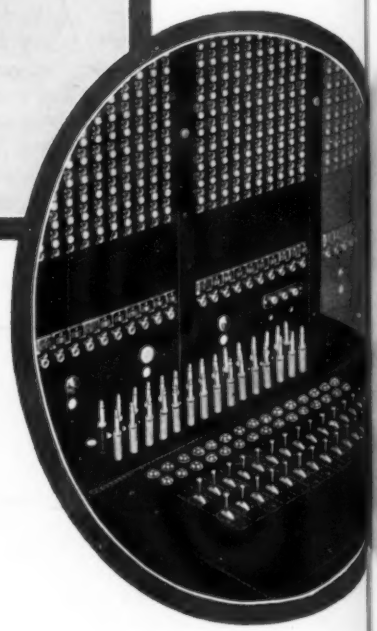

The keyshelf equipment of the combination magneto common battery switchboard is not changed for either type of service.

When equipped for magneto service
320 magneto lines.

When equipped for common battery service
400 common battery lines and
80 magneto lines.

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Will Magneto Board Meet All Demands of Exchange for the Next Twenty Years?

THE Monarch combination magneto and common battery switchboard will do just that.

The Monarch combination board is so designed and built that it may be installed for magneto service and later be converted to common battery service without rebuilding or remodeling. The few changes necessary for conversion are all arranged for at the time the board is built in our factory.

To convert to common battery operation, simply add two relays to the lamp supervisory cord circuits making them universal, and replace the drops and jacks with lamps and jacks for local lines.

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For Assuring Service All the Way to the Subscriber's Premises

the last 50 to 100 ft.—the drop wire—is as important as the miles of line back of it. Any failure of the drop wire destroys the usefulness of the entire line as far as the subscriber is concerned.

Minimize such failures by specifying

"COPPERWELD" "Ecco Brand" Insulated Twisted Pair Drop Wire

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Distributors to the Independent Telephone Trade

change it will be necessary to supply the manufacturer with sufficient information on the amount of traffic outgoing from and incoming to the planned exchange. In general this information is given as a certain number of calls per subscriber's line per busy hour or as a percentage of the total originating traffic.

The establishment of a correct and reasonable assumption for the amount of trunked traffic is probably the most difficult of the three traffic data treated in this paper. As a basis, observations made on the existing equipment may be used.

When both exchanges already exist, it is but a simple matter to make traffic observations on the "B" positions, but very often the new automatic exchange does not replace an old one but is required in addition to an existing exchange, from which it only takes over the subscribers situated in its area. In such a case the subscribers' lines which will be transferred may be marked in the multiple and answering fields and the operators will be instructed to note during the busy hour: First—all calls originating from the non-marked answering jacks and completed in the marked multiple jacks and second—the calls originating from the marked answering jacks and completed in the non-marked multiple jacks.

Should the number of subscribers' lines which will be transferred not be too great, these lines may be concentrated on one or more "A" positions in order to facilitate the observation.

From the figures observed, the average for the "out" and "in" traffic may be obtained, but this average must be established in exactly the same manner as explained above for the calling rate, i.e., by underestimating the trunked traffic for the same percentage of busy hours as that on which the calling rate was based. It is, therefore, preferable to make the observations of the calling rate and of the trunked traffic at the same time.

Assuming that the above method of observing the trunked traffic was followed for a 5,000 line exchange of which 500 lines will be transferred to a new automatic exchange with an initial number of lines of say 2,000. The figures observed in the manner stated above are, say:

Traffic originated by the 5,000 lines: 5,000 calls per busy hour.

Traffic from the 4,500 lines to the 500 lines: 338 calls.

Traffic from the 500 lines to the 4,500 lines: 360 calls.

Assuming for the new exchange a calling rate of 1, it will be obvious that it would be incorrect to assume that:

$$\frac{338}{500} \times 100\% = 67.6\%$$

of the traffic originated at the automatic exchange would be outgoing to the manual exchange, and that:

$$\frac{360}{4500} \times 100\% = 8\%$$

of the traffic of the manual exchange would be trunked to the new exchange.

By doing this it is not taken into account that the new exchange will have 2,000 lines, whereas the observations were made on 500 lines only. The result of this incorrect method of calculating would be that the traffic manual to automatic would be 400 calls and that the traffic in the reverse direction would be 1,350 calls, which is apparently incorrect.

The method to be followed in such a case may be as follows:

Assuming that the 4,500 calls originated by the manual subscribers are equally spread over the total number (5,000) of subscribers, the 500 future full automatic subscribers will then receive:

$$\frac{500}{5000} \times 4500 = 450 \text{ calls}$$

As observed, these subscribers receive only 338 calls, i.e., only 75% of 450 calls, the so-called "theoretical traffic."

The traffic from the 500 subscribers to the 4,500 subscribers which will remain manual should theoretically also be:

$$\frac{4500}{5000} \times 500 = 450 \text{ calls}$$

The number of calls observed being 360, 80% of the theoretical traffic of the new exchanges may be assumed as outgoing.

The future theoretical traffic between these two exchanges will be:

$$\frac{5000}{5000+2000} \times 2000 = 1430 \text{ calls}$$

The traffic from the automatic exchange to the manual exchange, when estimated at 80% of the theoretical traffic, as found above, will amount to:

$$\frac{80}{100} \times 1430 = 1144 \text{ calls}$$

and the traffic in the opposite direction, estimated at 75%, will be:

$$\frac{75}{100} \times 1430 = 1073 \text{ calls}$$

The "in" and "out" traffic will in general be approximately equal. Should observations show that there is some difference between these two traffics, this should again be carefully investigated as it will unbalance the traffic terminating on the subscribers' lines. If the number of "in" calls exceeds the number of "out" calls, the lines connected to say the manual exchange would receive more calls per line per busy hour than the lines connected to the full automatic exchange. Unless there are good reasons to the contrary, the "in" and "out" traffic must be assumed to be the same.

Such a reason for example may be that (as is generally believed) the traffic towards a large center exchange is higher than the traffic outgoing from this center. Many cases, however, are known where the contrary is true, so that this should not be accepted as a general rule.

Similar to this problem of trunked traffic between two exchanges is the case of toll traffic which is generally assumed to be equal for both directions. To mention a particular case, it was observed that in the years succeeding the war the toll traffic from England to Belgium was considerably smaller than that from Belgium to England. The direct cause for this, however, will immediately be clear when it is considered that the British telephone rates remained approximately on the same level whereas the rates from Belgium to England were always considerably lower on account of the fluctuations of the falling Belgian franc. For a case like this the reason can easily be stated why the traffic in one direction exceeds for some years the traffic in the reverse direction, but generally the fluctuations observed on automatic exchanges are only temporary and from repeated observations only may it be deduced that the traffic in one direction prevails.

For an area with more exchanges the estimating of the trunked traffic becomes more difficult, the number of possible cases is too great to consider them separately in this article. In most cases an experienced traffic engineer will find some indications on which he may base his assumptions, either by making observations in the subscribers' lines which will be transferred to the new exchange, or by making use of experience gained in similar exchanges in the same area.

In some cases the traffic data supplied to a manufacturer includes a separate holding time for trunked calls, which holding time then differs from the average given for the total originating traffic. Such may be the case when the calls between subscribers of a certain exchange are of a different class to the outgoing calls, for example local calls may principally be business calls, whereas the outgoing calls may be directed to an exchange serving resident subscribers mainly.

Call for Great Care

Every traffic figure must be carefully considered as it is likely that discrepancies will occur. An example is the case where it is stated that the holding time for calls trunked from Exchange A to Exchange B differs from that for calls in the opposite direction. It is then very unlikely that these figures are correct as it cannot be assumed that two subscribers, one connected to the Exchange A and the other connected to the Exchange B will have a shorter conversation when A calls, than when B calls.

It merely depends on the character of both subscribers and on their relationship to each other whether subscriber A or B will break off the connection.

The busy hour of the day is determined by observing for approximately one week the amounts of traffic originated by the subscribers during periods of say 15 minutes. The four subsequent readings which when summarized give the maximum traffic, determine the busy hour. The traffic outgoing towards another exchange or any other direction also will show a maximum during a certain hour of the day, but it will be obvious that this hour does not necessarily coincide with the busy hour observed for the originating traffic. In such cases the number of switches or trunks must not be based on the traffic observed during the busy hour, but on a higher traffic. There are telephone areas and this is especially true for large ones, in which the various classes of subscribers are distinctly separated and connected to different exchanges, e.g., an exchange in the center of the town may serve business subscribers only, whereas an exchange located in one of the outlying districts principally handles traffic from resident subscribers. The traffic between these exchanges may show a busy hour considerably different from that observed for the originating traffic.

From the above it will be evident that when it is intended to introduce into an area in the future full automatic service. it is necessary to make traffic observations. These observations must be taken regularly and with accuracy in order that they may be fairly representative of the total exchange traffic.

Studying the Details of Telephone Work

CHAPTER III

By E. R. COLLINS
Wire Chief, Manitoba Telephone System

Before we commence the study of the electro magnet, six more pictures of the magnetic field of a horseshoe magnet, such as is used in a magneto or telephone hand generator, will be of interest.

Experiment 12

It is suggested here, that instead of using the celluloid for our pictures of the lines of force, we use photographic paper. Glossy Velox post cards will possibly be the best form to use. Use a Benjamin two-way extension plug, with a red light of say 25 watt and a 100 watt clear nitrogen lamp. Place the post card over the magnet to be pictured, and with only the red light burning, sprinkle the iron filings. When the lines are made clear by tapping the card with a pencil, flash on the 100 watt lamp for about 15 seconds, then with the red light alone, again shake off the filings, and place the card in the developer. This will result in a sharp picture of the lines and will be much easier handled than the celluloid. With a horseshoe magnet and a piece of soft iron of about the same dimensions across as the magnet material, but long enough to lay between the poles of the magnet, leaving about 1/16 inch clear at each end. Make pictures with the soft iron in positions such as shown in Fig. 9 (1-6). Study the formation of the magnetic lines for each position.

If you will now refer to the picture made in Fig. 7 you will observe that there was very little evidence of any spread of the magnetic field, outside of the magnet. We have there what we called a closed field. If you will refer to Fig.9-1 you will notice a very similar arrangement. With two gaps at between the poles, and the soft iron. We refer to the soft iron piece in future as *the armature.*

It will be further noticed, that for every change in position of the armature, there is a corresponding change in the formation of the lines between the poles of the magnet, as shown in Fig. 9 positions 1 to 6.

The Electro Magnet

We will now endeavor to show the relation between the magnet and the electrical circuit. Early experimenters discovered, that a sheet of copper and one of zinc, immersed in sulphuric acid, would produce sparks when their outer ends were touched together. Such an arrange-

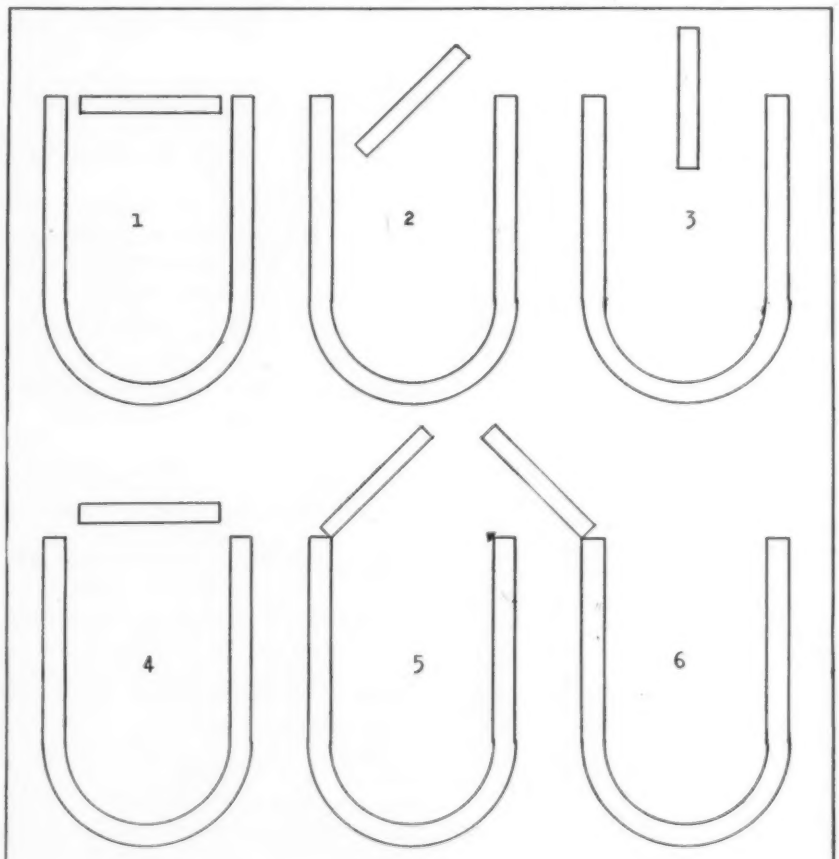


FIG. (9)

ment was called a cell and several cells connected together, were called a battery. We will not stop to consider batteries, except to say that by chemical means we can produce what is called a flow of electric current. The flow of current from such a battery during the life of the chemical action, is constantly in one direction through the connecting wire, which joins the two plates. Any material which will conduct such a current flow is called a *conductor*.

Conductors commonly used as copper, nickle, iron, bronze, zinc, carbon, certain acids and gases. The copper conductor is the one most commonly used.

Substances which will not conduct the flow of an electric current, are called insulators. Some of these are silk and cotton when dry. Rubber, asbestos, porcelain, glass and dry wood. There are also insulators, using trade names such as bakelite, celeron and fibers. These are nothing more than compounds of some of the above, so treated that they have very high insulating qualities, pleasing appearance, and great strength.

A copper wire which is covered with silk, cotton or rubber, or other insulating material, is called an insulated wire. A conductor without any covering is termed a bare wire.

Experiment 13

In Fig. 10 we show the cross section of a glass jar, partly filled with sulphuric acid and water. A large cork with two slits cut into it, has fitted in one slit a piece of sheet sopper and in the other a piece of sheet zinc. A coil of 20 turns, of say No. 20 cotton covered wire, is wound over a light paper tube and the coil thus formed is connected to the copper and zinc plates. Allow the whole apparatus to float in the acid solution, and let it float free till the coil turns in a north and south direction. Also test the ends of the coil for magnetic polarity, with a permanent bar magnet, used in previous experiments.

Repeat this experiment using clear water instead of the acid, and observe that the coil does not possess the magnetic properties. What has happened, is that the chemical action has produced an electric current flow through the wire in the coil, and this has set up a magnetic effect in the coil. We call such a coil a *solenoid*.

In telephone blue prints we show conventional marks called symbols to represent the different parts of the equipment. As it will be necessary to understand these markings in reading blue prints, we will show the conventional method of marking these as we proceed, and will use these in our sketches as we progress. In Fig. 11 we have the usual way of showing a battery, and a solenoid.

Experiment 14

Now use the same solenoid as used in Fig. 10 and connect the wires to two dry cells in series. Cut a post card so that it will slip through the coil as shown in Fig. 12, and with current flowing sprinkle the iron filings, magnetic lines will be

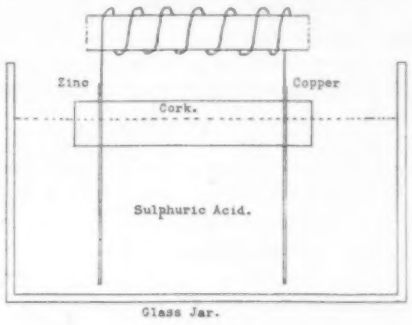
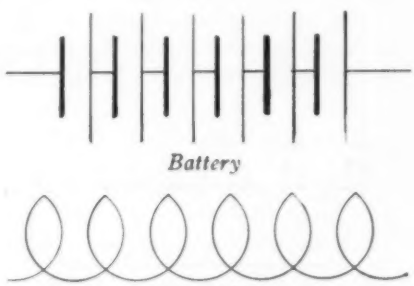


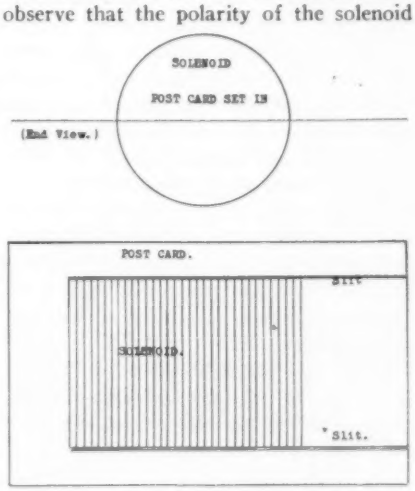
Fig. 10

seen closely formed in the center of the solenoid, spreading out at either end and circling back around the outside of the coil. It is evident there is some magnetic force at work, set up by the pas-



(*Fig.* 11)

sage of the electric current through the wire. Set the pocket compass at either end of the coil, and observe that it has a north and south pole. Now reverse the direction of the flow of current and also observe that the polarity of the solenoid



(*Fig.* 12)

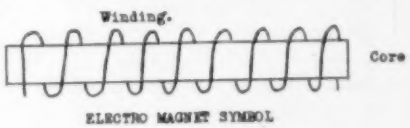
will be reversed as well. So we learn from this that the direction of the flow of the current determines the polarity of the magnetic field.

Repeat the experiment, and place a 5-inch nail in the center of the solenoid. The magnetic lines are more dense in this case. The iron center has lowered the resistance offered by the air to the magnetic field. We call such a solenoid a coil and the iron center the core, and the whole assembly of coil and core we call an *electro magnet*.

In Fig. 13 is shown the conventional method of showing an electro magnet.

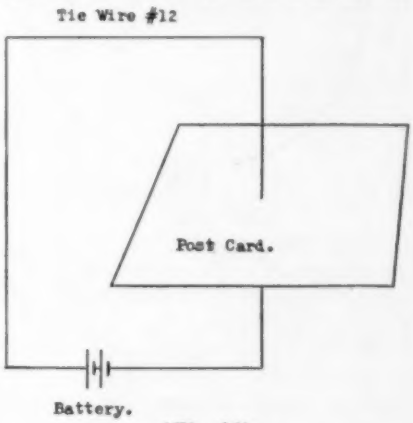
Experiment 15

Three experiments will now help to show how this magnetic field is set up. With a piece of No. 12 copper tie wire passing through a post card, and its two ends connected to a dry cell as shown in



(*Fig.* 13)

Fig. 14, sprinkle iron filings while the paper is in a horizontal position. If your experiment has been well done, faint lines will be observed formed in circles around the wire. These circles can be

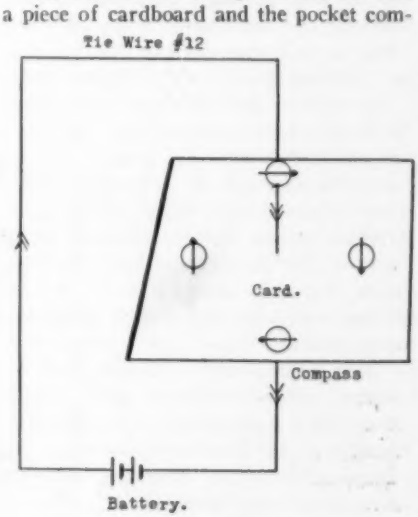


(*Fig.* 14)

traced for 2 inches away from the wire using one dry cell.

Experiment 16

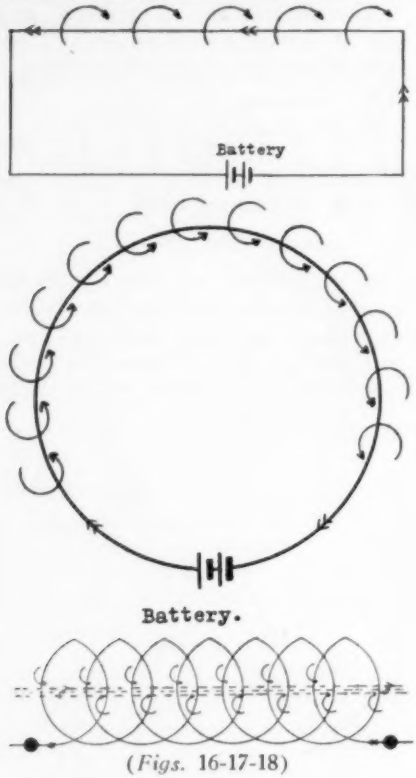
Repeat the above experiment, but use a piece of cardboard and the pocket com-



(*Fig.* 15)

pass. With current flowing set the compass at different positions as shown in Fig. 15. Note that the compass needle

is facing in one continuous direction always at right angles to the surface of the wire. Reverse the direction of the current flow, and the compass needle will also reverse. From this we learn, that the lines of magnetic force traveling around a wire through which a current is flowing, are in a circlar motion, and at right angles to the flow of current in the wire or conductor. The direction of the



(*Figs.* 16-17-18)

flow of current determines the direction of the magnetic whirls or circles set up.

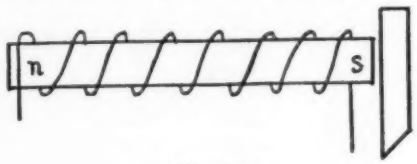
Experiment 17

Now set the compass so that when it is facing north and south, it will also be pointing directly towards the wire, with no current flowing. Now pass current through the wire first in one direction, then reverse, and observe that the magnet will set itself at right angles during current flow, but will return to its original position with no current flow. It is supposed that when the current starts to flow, the magnetic force travels out from the surface of the wire, and when the current ceases, the lines return to the wire in the opposite or receding direction. It is important to keep this in mind, as we will have occasion to refer to it quite often.

This experiment could have been repeated with the compass and cardboard at different levels along the wire and the results would have been the same. We therefore conclude that this magnetic force is exerted along the whole length of the wire or conductor.

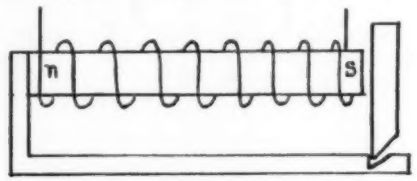
In Fig. 16 we can see what takes place in a straight wire, and if this wire were bent in a loop as in Fig 17, it follows that there would be a concentration of these magnetic whirls, and since they are are all turning in one direction, there would be a stronger flow of magnetic force toward the center of the loop. Then if we increase the number of turns of the wire as in Fig. 18, we can multiply the magnetic force exerted in one turn or loop, by the number of loops in the larger coil.

In Fig. 16 and 17, we could make pictures of the magnetic lines by having the wire laid flat on the table, with a post card over it, over which we sprinkle the filings. These pictures would show the



(*Fig.* 19)

lines of force at right angles to the length of the wire in both cases. In Fig. 16, 17 and 18, the flow of current is shown by the double arrows, and the magnetic flow by the circle arrows. In Fig. 18 the



(*Fig.* 20)

general magnetic effect, is shown by the dotted line and arrows. This is also shown on the post card picture in Fig. 12.

Experiment 18

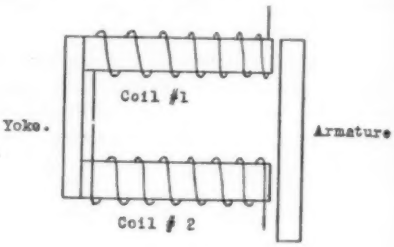
Now we have in Fig. 19 an electro magnet with a soft iron armature. The core will be of soft iron as well so that when the current is cut off from the coil, there will be little if any magnetic force in the core. With such an apparatus we can cause a mechanical action to take place from a distance. When the current is flowing the armature will be pulled up, and when the current is cut off the armature will fall away. This principle was first made use of in the Morse telegraph sounder with which we are all familiar. With the magnet in Fig. 19 laid horizontal, make a picture of the magnetic field.

Experiment 19

In Fig. 20 we have added a yoke or a heel piece to our electro magnet, with one end of the armature resting on the heel piece. Make pictures of this with the armature removed, with the armature blocked ¼ inch away, then 1/16 inch away from and then touching the core. Observe the pull of the armature at different distances from the core. Compare the pulling power of the magnet with the magnetic pictures.

From these experiments we can learn that, *the less the spread of the magnetic field away from the magnet the greater the pull on the armature. And the smaller the gap between the core and the armature. The greater the pull on the armature.*

Where heavy pulling power is required from an electro magnet, two coils are arranged as in Fig. 21. Here both the sides of the magnetic field are working forces. with the yoke and the armature completing the magnetic field set up. One thing to observe in such cases is that the windings are connected in such a way that the resultant polarity of the cores will assist each other. As it is not always possible



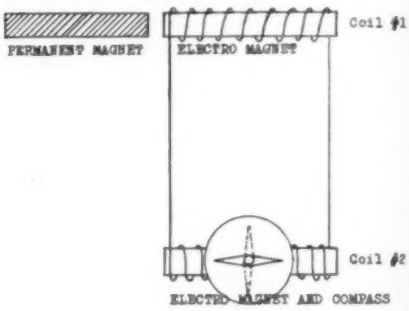
TWO COIL ELECTRO MAGNET WITH ARMATURE.

(*Fig.* 21)

to see the direction of the winding of commercial coils, it is often necessary to try both ways to see which gives the strongest pull. We will refer to this again under apparatus affected.

Electro Magnetic Induction

While this subject may be a little out of place it will be necessary to refer to



(*Fig.* 22)

it as it is the first phenomena we notice in the study of the telephone art.

Experiment 20

Connect two ringer coils, of equal size and resistance with two wires about 5 ft. long. Lay a book over the wires about half way between to keep any motion of one coil from moving the other. Now place the pocket compass over one coil so that the needle will point the same way as the core of the coil, as shown in Fig. 22 coil No. 2. Use one of the bar magnets used in the first experiments, bringing it quickly towards one end of coil No. 1. Observe the action of the compass needle as the magnet is brought to and then away from the coil No. 1. Allow enough time between movements to permit the compass needle to come to rest. When the magnet was brought towards the coil, the compass swung say

to the right; and when the magnet was drawn away, the compass swung say to the left. Coming towards coil caused the compass to swing one way and going away caused the compass to swing the other way.

In Fig. 22 we allow the permanent magnet to remain in contact with one end of coil No. 1, and bring a piece of soft iron towards the other end of coil No. 1. We will observe the same results with the compass as in the previous experiment.

It might be well to make post card pictures of the magnetic field of Coil No. 1 with the armature touching the core, with it blocked ¼ inch away, and

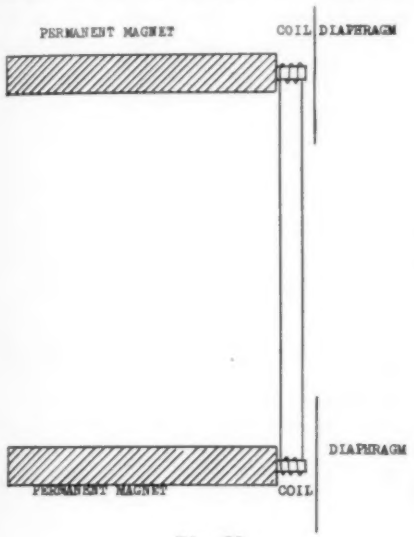


Fig. 23

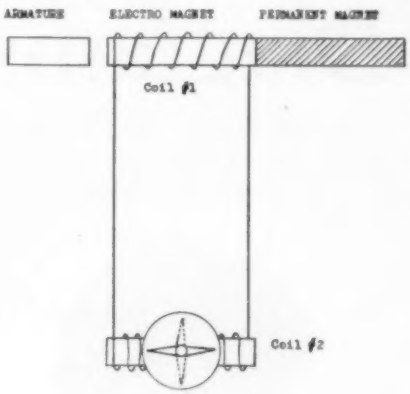
with it removed entirely. The magnetic field will be different in each case.

Now it should be quite within reason to expect that if passing an electric current through an electro magnet causes a magnetic disturbance, then causing a magnetic disturbance in an electro magnet should cause a flow of electric current.

This is actually what happens. The magnetic disturbance caused by the bar magnet approaching causes an electric current to flow momentarily through its coil, and through Coil No. 2. This causes a magnetic disturbance on Coil No. 2 which is evident by the movement of the compass. Then as the disturbance ceases the current ceases. Then the disturbance caused by the removal of the magnet, causes another disturbance in the opposite direction, causing a current to flow during the time of the magnetic disturbance, and this in the opposite direction. This change in the direction of the current flow is seen by the change in the direction of the compass deflection. We have here then the connecting link between magnetic disturbance and current flow.

The Magnetic Telephone

In Fig. 24 we have shown two permanent magnets with the pole pieces made small and short. The reason for this will be explained later. Around the pole pieces is wound the coils which are



(*Fig. 24*)

connected by two wires. Close to the pole pieces but not touching are two thin circles of soft iron. These will be pulled slightly towards the pole pieces by the strength of the magnets, but are not allowed to touch because the rim of the circles is held solid. Now if one circle which we call the diaphragm, is caused to move in or out, it will cause a magnetic disturbance, and this in turn will cause a flow of current in its coil. This current will flow over the line wires, through the other coil, causing there a magnetic disturbance. This magnetic disturbance will vary the pull on the diaphragm, or circle, and cause it to move in unison with the movement set up at the first coil. Now if the moving power be the human voice as in Fig. 2, it is quite obvious that the effect of the human voice will be reproduced at the other end. Such in brief is the action that takes place. Here we have replaced the string of experiment No. 2 by a magneto electric apparatus. The sound of the human voice is transmitted by the same process of sound wave motion, but the connecting link here is electrical instead of mechanical.

In our next article we will take up some means employed to extend the distance of voice transmission, also means of signalling.

P. C. Burns, Independent Pioneer Manufacturer, Dies

Chicago, Ill.—Peter Cooper Burns, chairman of the board of the American Electric Company, Inc., died at Wesley Hospital, Chicago, March 22, of peritonitis following an operation for appendicitis. Mr. Burns was 62 at the time of his death. Interment was at Fond du Lac, Wis., the home of his surviving brother, James A. A sister, Mrs. M. F. Martindale of Nashville, Tenn., also survives him. Mr. Burns was a bachelor.

With the passing of the widely known "Paddy" Burns, the telephone industry suffers another great loss in the thinning ranks of the bold figures who made telephone history. He stepped, at the age of 16, into the drive of telephonic development from which he emerged as one of the leading figures. He was employed by the Bell company as an operator and later as an inspector at the Chicago exchange. He then worked in making Bell apparatus at the factory of the Electrical Merchandise Company and later became a salesman for this company, which eventually became known as the Knapp Electric Works.

Burns was an energetic factor in starting new enterprises. He started the first electrical supply agencies on the south side of Chicago and in St. Louis. He established and conducted the St. Louis Electric Supply Company, the Findlay Glass and Carbon Company, the Peru Electric Company, the Laclede Carbon and Electric Company, the American Electric Telephone Company, the Rose and Rein Electrical works and the Peru Porcelain Works. He went aggressively into the struggling Independent telephone operating field in the middle nineties, and by his vigor and inventive ingenuity, as well as his fearlessness walked boldly in where angels feared to tread and came out winner a good part of the time.

For 45 years Burns kept constantly at the job of pushing the Independent field forward. He had a lengthy list of notable achievements credited to him, among which were the standard compact magneto telephone cabinet, the concealed binding-post receiver, the first commercially successful self-restoring drop switchboard, the present standard type of desk stand, the adjustable headband receiver, the harmonic type ringing system, the removable lever switch-hook and the granular carbon "long distance" transmitter. These were but a few of Burns' technical achievements dating from the years in the '80s when we went into the telephone manufacturing business on an aggressive scale. Then the Bell-Independent manufacturing fight was the hottest. He and Eugene L. Brown, a druggist of Noblesville, Ind., joined forces and as a result the Independent movement was put under way in Indiana.

Many of the foremost figures in the Independent industry today were close associates of Mr. Burns during some period of his active career and they, with the rest of the industry, lament the passing of this valiant figure.

How to Read Telephone Circuit Diagrams

By DAVID S. HULFISH

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CHAPTER III.

Switchboard Elements

For a preliminary understanding of switchboard principles, a short study of circuit diagrams representing the simplest types of switching will be made.

A telephone switchboard consists fundamentally of two classes of apparatus. First, there are the line terminals. Second, there are the devices for connecting together the line terminals. All other apparatus is auxiliary to these two fundamental classes.

Each line terminal is equipped with a device which presents the electrical conductors of the line in a manner ready for the attachment of other conductors, so that the line may be extended electrically by attaching connective apparatus at the will of the switchboard operator.

The connecting apparatus, or second division of switchboard devices, consists fundamentally of flexible cords, each cord having a free end and a fixed end, the fixed ends being jointed in pairs, and each cord at its free end having a plug for attaching it temporarily to the terminal of any line. It will be seen that a pair of these flexible cords may be taken by the hands of the operator and the two plug ends fastened to the terminals of two lines, and therefore to the conductors of two lines. By such an act on the part of the operator, the two lines would be connected together electrically, and users of the telephones upon the two lines might talk with each other.

So far as talking is concerned, these terminals and connecting cords provide a simple switchboard. In addition to the facilities for talking, there must be provided signaling means, both to enable the telephone users to signal the operator (to "call central") and to enable the central office operator to ring the bells of the telephones.

Studying the line terminals first, the simplest switchboard provides each of the lines with a small device which has a shutter or "target" similar to the annunciator drops used in hotels for calls from the guest rooms.

In a small, simple switchboard which serves magneto lines, each line terminates in one of these "drops" associated with another line-terminal device called a "jack." At the other end of the line is the substation telephone set. This condition may be studied by means of a diagram.

David M. Hulfish

Fig. 121 shows the annunciator drop. The magnet spool has at the right a comparatively heavy armature, pivoted at the top, from which a light finger or "reed" extends above the top of the magnet toward the left and ends in a hook. Under the hook is positioned a light drop shutter, hinged at the bottom, and inclined toward the left, so that it has at all times a tendency to fall. This shutter may be non-magnetic, that the magnet core will have no effect to withhold it from falling. When current flows through the wire winding of the magnet spool, the core attracts the armature, the armature swings and lifts the hook end of the reed, and the shutter is released. The shutter falls visibly and may be restored by the hand of the operator after current through the spool has ceased.

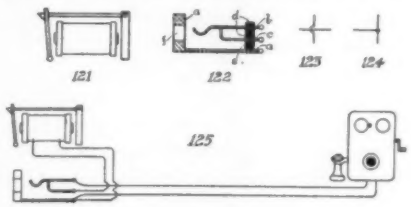
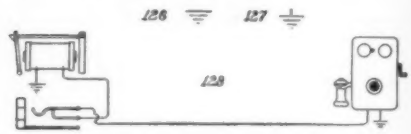
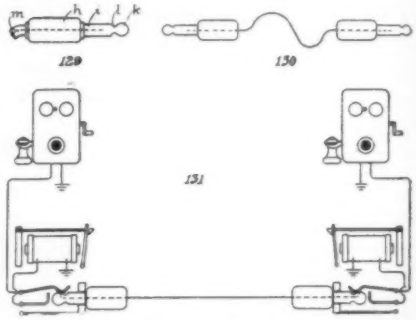


Fig. 122 shows a simple jack of the kind used in small switchboards. In mechanical construction it consists of a cast body indicated by the letter *a*, upon which casting are mounted the moving spring *b* and the fixed contact point *c*; insulation is provided at *d* and *e* to keep the three parts electrically separate. The jack body is drilled at *f* with a hole usually one-quarter of an inch in diameter.

Conducting wires are represented by simple lines, as shown in Figs. 123 and 124. In Fig. 123 the lines are represented as crossing without touching, the vertical wire jumping over the horizontal wire, if one chooses to think of it in that way. In Fig. 124 the wires are definitely joined. The small circle may be taken to represent a soldered joint between the vertical wire and the branching horizontal wire.

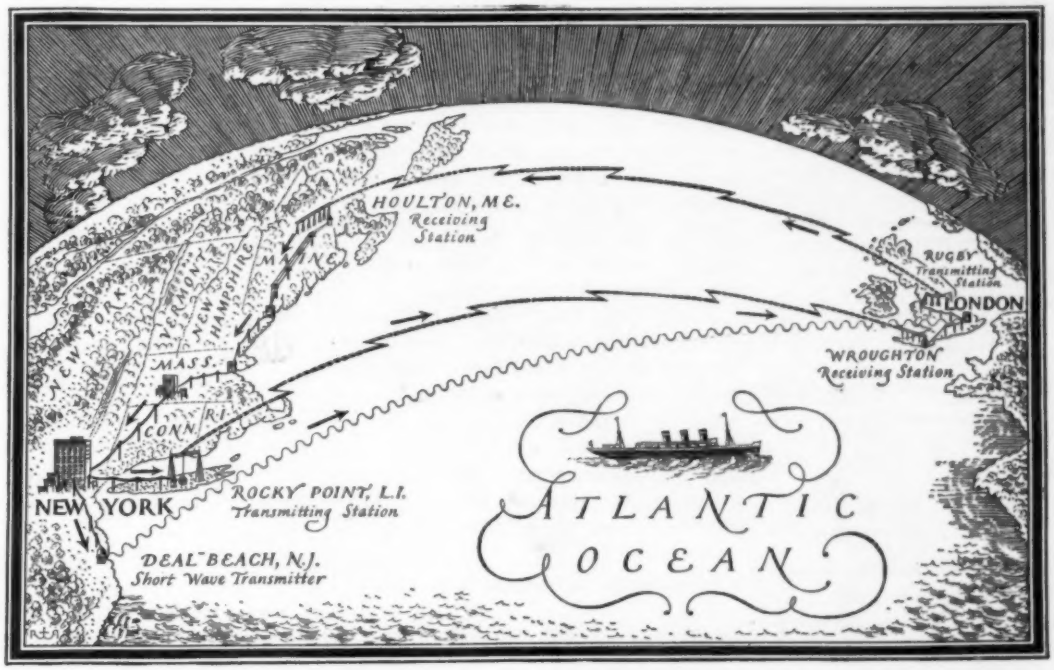


The assembled apparatus in Fig. 125 represents the complete switchboard equipment of a subscriber's line in a small magneto switchboard, together with the two wires of the line itself, and the substation telephone. The substation telephone here is symbolized, the case rather than the circuits being presented. The circuits may be one of the substations of Fig. 118.



By turning the crank, an alternating current is sent out over the line wires, sufficient in strength to cause the magnet of the drop to attract its armature, lifting the reed and releasing the shutter. This is called "tripping the drop" or "throwing the drop." It is seen that the drop magnet in Fig. 125 has the same relation to the substation at the right of the figure that the ringer of the left-hand substation of Fig. 118 has to the substation at the right of Fig. 118, and that any current sent out from the substation telephone at the right of Fig. 125 must pass through the magnet of that drop, and "ring the drop down" instead of ringing the bell of a distant station.

The telephone system of Fig. 125 may be simplified by changing the diagram



The Radiophone's Meaning

An Advertisement of
the American Telephone and Telegraph Company

AN ADVENTURE in communication was made last January when transatlantic radio telephone service was established between New York and London. There had been previous tests and demonstrations. Nevertheless, the fact that at certain hours daily this service was made available to anyone in these cities from his own telephone, created such public interest that for several days the demands for overseas connections exceeded the capacity of the service.

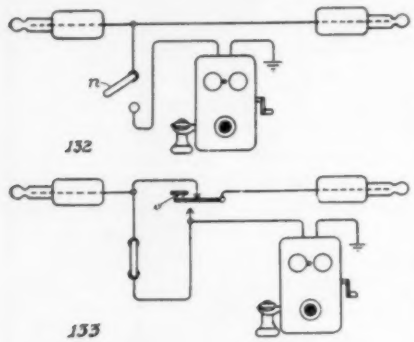
It was then demonstrated that there was a real use for telephone communication between the world's two greatest cities. It was further demonstrated that the American Telephone and Telegraph Company, with the co-operation of the British Post Office, was able to give excellent transmission of speech under ordinary atmospheric conditions.

In accord with announcements made at that time, there will be a continued effort to improve the service, extend it to greater areas and insure a greater degree of privacy.

It is true that static will at times cause breaks in the ether circuit, but a long step forward has been made towards international telephone communication and more intimate relationship between the United States and Great Britain.

to show a "grounded line." See Fig. 128. The symbol for "ground" or "earth return" is shown in Fig. 126, and with a connected "earthed conductor" is shown in Fig. 127.

A "grounded line" is a telephone line in which but one wire is strung on the poles, and the earth, which is a fairly good conductor under most circumstances, is used as a return path for the telephonic currents. Grounded lines are used for many farm lines, and were used exclusively for all telephone lines when the telephone was first used.



In Fig. 128, when the crank is turned, current flows from the substation telephone set over the line wire to the moving spring of the jack, then to the fixed contact point of the jack, then to and through the drop magnet, then to ground or earth, thence by means of the conductivity of the earth to the ground connection of the substation, and up the ground wire to the telephone set, completing the circuit and energizing the central office drop.

In response to the falling of the subscriber's drop, the operator must connect with his line, and must connect his line with any line desired. This is the purpose of the central office, and the reason for its existence.

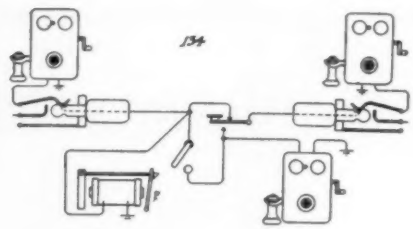
The connecting device is shown in Fig. 129. For switching grounded lines, where but one conductor is required, the plug proper consists of a solid body of metal, usually with a shielded handle. The handle is indicated at *h*, the shaft or "body" of the plug at *i*, the tip of the plug at *k* and the reduced neck at *l*. A flexible conductor is shown at *m*, connecting through the dotted line to the metallic or conducting portion on the plug. A pair of plugs on a flexible conductor are shown in Fig. 130, and two subscriber's lines connected by a pair of plugs and a flexible cord are shown in Fig. 131. The operation of the plug of Fig. 129 when inserted in the jack of Fig. 122 is to engage and lift the moving spring away from the fixed contact point. This condition is shown in Fig. 131. The bent portion of the spring *b* of the jack of Fig. 122 tends to hold the plug in place by taking a seat in the neck *l* of the plug, until the plug is forcibly removed by the operator.

In Fig. 130 a switching device is shown in its simplest conception, and in Fig. 131 it is shown in use.

The first requirement for the refinement of the crudely simple device of Fig. 130 is that the operator be enabled to talk with the calling subscriber. This introduces the "listening key" which permits the operator to connect her telephone with a plug. This is the switch at *n* in Fig. 132. The operator thus may talk with the calling subscriber, and may ring the bell of the called subscriber by turning the crank of the central office telephone set shown in the diagram.

With the diagram of Fig. 132, the ringing current would divide, some to the station to be rung and some to the station calling, thus "ringing in the ear" of the calling subscriber. Another refinement now is placed in the connecting device, this one being called a "ringing key." It is shown in Fig. 133. By depressing the knob *o* after opening the listening key, the central office hand generator is connected to the station to be called without being connected to the station calling.

Still another refinement is required before the connecting device becomes fundamentally suitable for use in the simple switchboard of today. The telephone users must be able to call the operator even when they are connected. For this purpose a drop is added to the connecting device, or cord-pair, as shown at *p* in Fig. 134. In case either of the subscribers connected as shown in Fig. 134 should turn the crank of his telephone set, current would flow from his generator, over the line wire to the central office, where it would divide, some going to earth through the clearing drop and some continuing to the remaining plug and over the connected line to the other substation of the connection, actuating the ringer of that telephone set. Thus he would ring both the central office drop and the distant connected substation bell. Fig. 134 shows a complete connecting device, symbolized to its greatest simplicity.



A cord pair, or connecting device, for metallic-circuit lines, is shown in the diagram of Fig. 135. As compared with "grounded" lines, the "metallic" line has two conductors instead of one. The plugs must carry two conductors, an insulating separation being made between the tip and the body of the plug. The cords must carry two conductors, one connecting tip to tip and the other connecting the plug bodies, as shown by the dotted lines in the figure. In the listening key, there are two long springs and also two short springs with which the long springs make electrical engagement when bent by the black wedge of insulation, which is arranged to bend both long springs at the same time. In the ringing key also, the springs are duplicated.

The talking equipment of the central office is shown separate from the generator, which is the custom in switchboards. The clearing drop is connected from wire to wire at such a point that it does not get current from the central office generator.

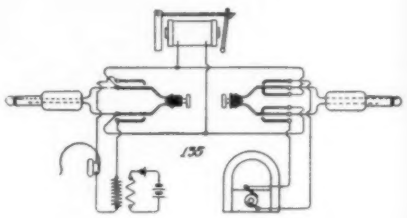


Fig. 125 has shown a metallic circuit equipment for a subscriber's line. Fig. 135 shows a cord pair or connecting device suitable for connecting together two lines such as shown in Fig. 125. As an exercise in reading circuit diagrams, the student may draw two lines as shown in Fig. 125 and connect them by the device of Fig. 135. Skill in reading will be promoted by the act of drawing the suggested diagram, as well as by reading it afterward. The movable spring of the jacks must connect with the tips of the plugs, but not with the bodies of the plugs, and the movable springs are lifted from the contact points or short springs when the plugs are inserted, as shown in Fig. 134.

Substation Symbols

Changes in central office equipment may be made without any change in the substation. The dependence between the two pertains to general principles only. In any circuit diagram dealing with a switchboard, the details of the substation may be assumed to be cared for by another diagram, or otherwise, and for a study of the switchboard circuits it is required only that a substation be indicated, without a definite specification of its minor details. A need exists, then, for a symbol to indicate a substation telephone as a whole, without details, it being assumed that the telephone is proper to operate with the switchboard shown.

The simplest, and at the same time the most comprehensive of such symbols, is Fig. 136. Merely a hand telephone. An amplification is given in Fig. 137. The device adjacent to the receiver in Fig. 138 might be hookswitch contacts such

RECOMMENDATIONS

The recommendation of an organization to which you can present your telephone problems, implies, among other qualifications, experience and knowledge of the telephone industry on the part of the men who represent that organization.

The Continental Telephone Company is under the management of men who are and have been actively engaged in the telephone business for many years, and who have been responsible for the success of three of the outstanding independent telephone systems in the United States.

The Continental Telephone Company invites correspondence from independent telephone companies anywhere in the United States who desire to market their properties.

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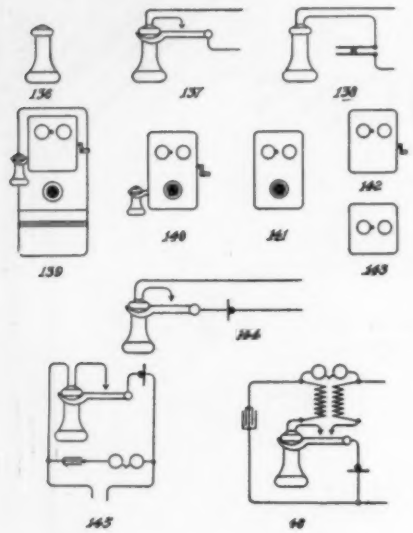
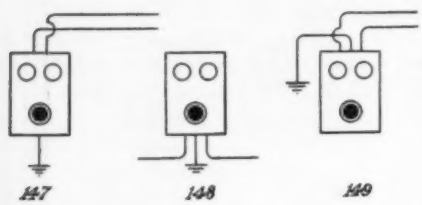
President .....
Secretary .....
Number of Company Owned Telephones .....
Number of Exchanges .....
What Type of Plant—Magneto ☐ **Manual** ☐ **Automatic** ☐
City ..... **State** .....

as those of Fig. 71 with the hook lever not shown, or it may represent a transmitter as in Fig. 22. The meaning of such a part is immaterial, when it is seen that as a whole Fig. 138 is intended to



represent a complete substation equipment. A common symbol is that of Fig. 139; it is a picture rather than a symbol; it is non-committal as to electrical circuits. Fig. 140 is a slight simplification; Fig. 141 omits the crank from Fig. 140. Fig. 142 reduces the symbol further by omitting the transmitter and Fig. 143 simplifies still further by omitting the



crank. While Fig. 143 shows a ringer only, the complete substation is to be understood if the remainder of the diagram require it.

In circuit diagrams dealing with central energy systems, the electrical conditions of the substation are simpler than those of a magneto substation having local battery transmission, consequently the electrical circuits are more likely to be shown. Notice Fig. 144, which shows very simply a complete talking equipment for a common battery substation.

Fig. 145 repeats the symbol of Fig. 144, but adds a ringer, bridged from wire to wire of the line pair, with condenser in series to prevent the flow of battery current. Fig. 146 presents another substation in circuit form which is so widely used that it has become an integral symbol for a common battery substation equipment, and should be read as such.

Many line and substation circuits require, in addition to the two line wires, a ground connection in fulfillment of some of the requirements of the central office apparatus. Such a condition may be indicated by a third conductor leading in any manner from the substation symbol to an earth symbol near it. Figs. 147, 148 and 149 show this variation as applied to a symbol of the type of Fig. 141.

A drawing forming a part of a United States patent is taken as the basis for Fig. 150. In this, a party line is shown diagrammatically. The line consists of two branching conductors terminating in telephone substations presumably all alike. Diagrammatic representation of one sub-

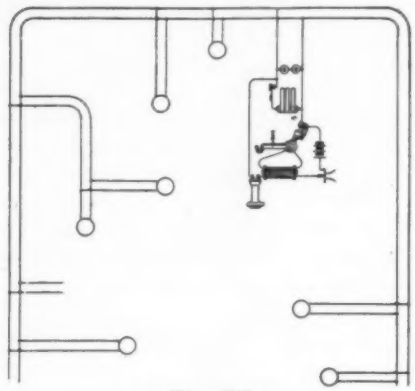


Fig. 150

station is made, but the remainder are merely indicated by circles.

Finally when a pair of conductors run from a switchboard line-terminal to any nondescript symbol, it may be assumed in beginning to read the diagram that the nondescript indicates a complete substation equipment of such character as to operate in harmony with the central office equipment.

Jacks and Plugs

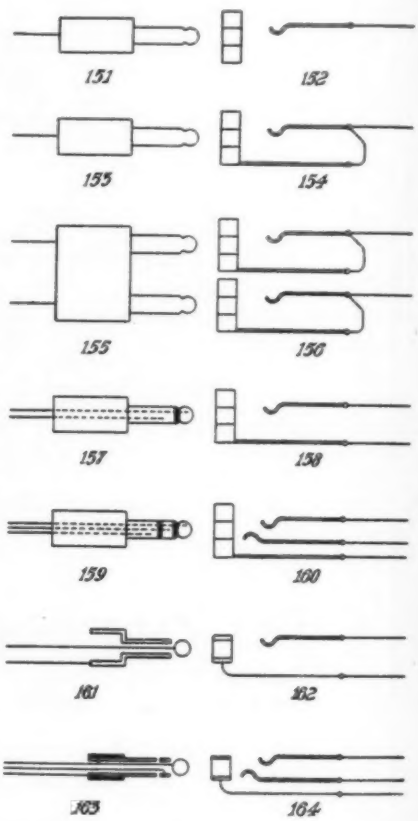
The jack and the plug jointly form a switching device. It is more logical to consider them as co-operating parts of a switching device which may be separated, similar parts of many such switching devices being interchangeable.

The jack is a fixed switch member, usually presenting at the face of the switchboard a tubular mouth portion, behind which are spring members, some of them possibly being electrical switches within and among themselves. The body of the jack surrounding the mouth usually is of conducting metal.

The plug is a companion member to the jack, and is adapted to engage certain or all of the jack members. The plug comprises a handle for its manipulation and a projecting shaft for entering the jack and for engaging the springs at the rear of the mouth of the jack. Of conductors, the plug may have one or more; the jack likewise may have one or more conductors to engage electrically the conducting portions of the plug. The plug and the jack which are to co-operate must be designed for each other; beyond this, there are variations in design which are likely to influence the symbols used to represent the devices.

In Figs. 151 and 164 are presented plug symbols where the plugs are not specialized and also jack symbols most usually met where the jacks are merely offering terminals for the connection of conductors in the plug, without any switching of conductors within the jacks themselves. The solid plug, or one-way plug, is shown in Figs. 151 to 156.

Fig. 157 shows a plug of the same general type, but having two conductors, the tip being insulated from the shaft or body. Fig. 159 shows the body divided; the three conducting portions of this plug are named "tip," "ring" and "sleeve," reading from right to left of the figure. Fig. 158 shows a jack to take the two conductors of the plug of Fig. 157 separately. Fig. 160 shows a jack in which



a second spring is present to make contact with the ring of the plug of Fig. 159.

The plug symbols of Figs. 151 to 159 represent side views of the plugs, while Figs. 161 and 163 represent sectional views.

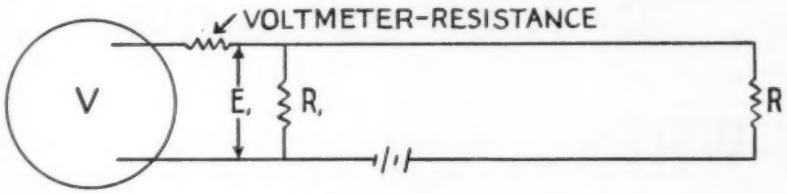
In the figures, a plug and a jack are set opposite to each other, the plug being adapted to cooperate with the jack opposite to it; this brings out the relation which exists between plug and jack, and this is the position in which the two parts usually are found in a diagram. Sometimes the plug is shown in the jack; see Figs. 131, 134 and 179.

(To be continued.)

LINE AND DESK

HOW VOLTMETER RESISTANCE SCALES ARE COMPUTED

The following is contributed, with the hope that deskmen, who use the voltmeter for making tests and who are not familiar with the computations that make up the resistance scales, from the voltmeter readings, may have a better idea of how the values are computed. The two methods considered are proved algebraically; the first method can be best applied for low resistance measurements and the latter for higher ohmic values:



"A" Method

(A) Using a known resistance and unknown resistance in series with the test battery.

R_1 = Known resistance.
R = Unknown resistance.
E = Test battery voltage.
E_1 = Voltage drop across known resistance.
I = Current in circuit.

Neglecting the resistance of the voltmeter, we will start with a simple series circuit, having R and R_1 in series with the test battery.

Ohms Law—Voltage = current × resistance.

Then $E = (R + R_1)\ I$ for the entire circuit.

$$I = \frac{E}{(R + R_1)}$$ (This value is the same for any part of the circuit.)

E_1 = Voltage drop across known resistance, having current $\frac{E}{(R + R_1)}$.

Substituting this value for I in the second fundamental equation we have:

$$E_1 = \frac{E}{R + R_1}. \quad R_1 = \frac{ER_1}{R + R_1}$$

$$R + R_1 = \frac{ER_1}{E_1}$$

$$R = \frac{ER_1}{E_1} - R_1 = \frac{ER_1 - E_1R_1}{E_1} = \frac{R_1(E - E_1)}{E_1}$$

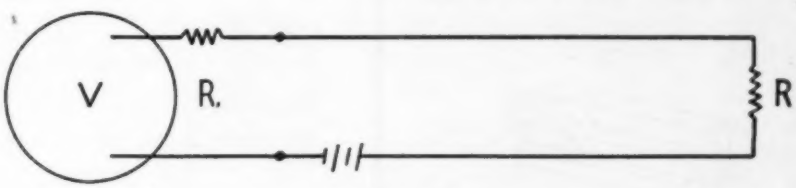
$$R = \frac{R_1(E - E_1)}{E_1}$$

Note—More accurate results may be obtained by substituting the joint resistance of voltmeter and R_1.

(B) Using voltmeter in series with test battery and unknown resistance.

R_1 = Resistance of voltmeter.
R = External resistance.
E = Test battery voltage.
E_1 = Voltmeter reading with external resistance in circuit.
I = Current in circuit with voltmeter and test battery in series.
I_1 = Current in circuit when R and R_1 are in series.
$E = IR_1$ with voltmeter and battery in series. And
$I = \frac{E}{R_1}$. Current required to give full voltage reading.

The current required to make a deflection of 1 volt on the voltmeter scale would be $1/R_1$.



"B" Method

Thus the current required to make E_1 volt deflections would be $I_1 = \frac{E_1}{R_1}$.

Considering the circuit with external resistance we have $E = (R + R_1)\ I_1$.

Substituting $\frac{E_1}{R_1}$ for I_1 we have:

$$E = (R + R_1)\left(\frac{E_1}{R_1}\right) = \frac{E_1(R + R_1)}{R_1}$$

$$R + R_1 = \frac{ER_1}{E_1}$$

$$R = \frac{ER_1}{E_1} - R_1 = \frac{R_1(E - E_1)}{E_1}$$

$$R = \frac{R_1(E - E_1)}{E_1}$$

NOT EVEN A GROUND HOG

J. J. Coughlan, of Des Moines, tells us about a man who was making application with the foreman of a line crew for a job.

"Can you climb?" queried the foreman.

"Sure. Just like a squirrel," came the reply.

Soon after the foreman had assigned the man to a job of working on a pole, he was attracted by a commotion. Hurrying over he found the latest recruit huddled near the base of the pole from which he had fallen.

"I thought you said you were a regular squirrel," roared the foreman.

A feeble voice replied, "I meant a ground squirrel."—Northwestern Bell.

MAKING WOOD LAST LONGER

Our telephone, telegraph, railroad, and power companies have made great progress in the treatment of poles, for they are now treating 2,500,000 poles annually, which is 6½ times the number treated in 1909. About 3,250,000 poles are used annually. Good creosoted pine poles in the South will give a life of 30 years and in the North of 50 years.

Since 1909 we have creosoted approximately 13,000,000 pieces of crossarms—an average of 770,000 pieces per year—and are now treating over 1,000,000 crossarms annually, which is 15 times the number treated in 1909. It is estimated that about 10,000,000 crossarms are used annually, of which only 10 per cent now are treated.—Grant B. Shipley in "Wood Preserving News."

HOW ACCIDENTS HAPPEN

A man was working on a toll pole and started to step from his platform to the pole, which had no steps. He placed one spur in the pole and his other foot

slipped on paraffin that had been spilled on the platform.

If the platform is kept clean there is little chance for a man to slip. Only ordinary precautions are necessary to prevent such accidents.—"Southwestern Telephone News."

INSTALLATION AND CARE OF PROTECTOR PARTS

That adequate protection for central office and sub-station equipment is necessary has been proven beyond a doubt, but unless the protective equipment is properly installed and maintained, it often causes more trouble than it prevents. Oftentimes trouble in protectors can be traced to careless assembly of carbons and dialectrics or, as they are commonly called, micas.

A careful examination of a carbon block will reveal that it has been cut or sawed from one side, leaving one edge clean and smooth and the other slightly rough. The rough edge should always be placed down to avoid small pockets forming and accumulating dust which sifts down through the carbons and

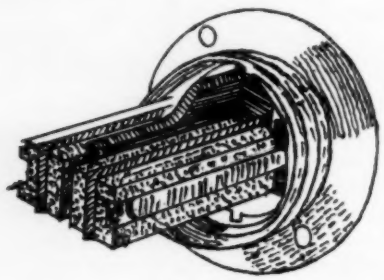


Fig. 1

eventually causes trouble. Care must always be taken to place the slot in the mica down and edges flush with the bottom of the blocks. This leaves the upper edge slightly elevated above the blocks as indicated in drawing No. 1.

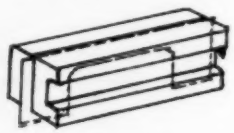


Fig. 2

If the mica is placed low as shown in drawing No. 2 a channel is left between the blocks which will accumulate dust and cause a leak to ground. If the mica is placed slot up as shown in drawing No. 3, a pocket is left for the accumula-

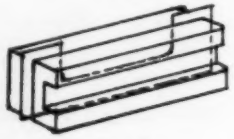


Fig. 3

tion of dust and trouble. A very good plan is to have one hundred or more sets of spare carbons and micas so that at certain periods or after a severe electrical storm, all the protector blocks can be changed by sections.

When the burned or blistered carbons are taken out they should be thoroughly washed in fresh clean water to remove all the loose particles of carbon and dust. They should then be laid out in a warm place until thoroughly dry. The operating surface should be rubbed over a clean piece of cheese cloth, under moderate pressure, until there is no evidence of soil on a clean piece of cloth. A careful inspection should then be made of the clean carbons.

A carbon which shows signs of burns either on the operating surface or on the fusible metal globule, if equipped with one, should be rejected. Micas that show any discoloration or burns at edges should likewise be rejected. A carbon should never be scraped with a knife or rubbed on a rough surface to clean it. The gap is usually adjusted to from .005 to .008 inches and anything except very careful cleaning will alter this adjustment and change its protective qualities.

Until such time as new equipment has been developed and has demonstrated its value, we must make the best of our present protective devices which are much better than they were a few years ago and are excellent insurance. When junk it.—By Ray Blain.

Spring housecleaning at your exchange

WHEN the spring housecleaning takes place in the exchanges as well as in the homes, there are going to be a lot of Runzel-Lenz cord users again impressed with the fact that the durability of these cords is greatly above the average.

RUNZEL-LENZ cords serve with such complete freedom from trouble, repairs and replacements that they run the risk of being "out of sight; out of mind." But not with the careful and experienced manager. He knows that these superior cords are always on the job, saving money and serving many calls long past the life of the ordinarily good cord.

INVESTIGATE Runzel-Lenz cords —their method of manufacture and their service records. Then you'll standardize on them.

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Practical Session Feature North Dakota Convention

Bismarck, N. D.—Not daunted by bad weather and miserable road conditions the North Dakota Telephone association held its twenty-first annual convention here and went through with a practical program of intimate interest to the state's representative telephone men who were present in good numbers.

A. T. Nicklawsky, Hillsboro, was re-elected president. Other officers elected were: D. L. Vail, Milnor, vice-president; F. R. Irons, Starkweather, secretary-treasurer. H. A. Brown and M. M. Borman were re-elected directors. Evan Griffith, Kenmare, was newly elected to the directorate.

The opening session of the convention was taken over by committee chairmen making their annual reports. Among these reports was the one on the district conferences made by W. M. Ricker. North Dakota's four district conferences held during 1926 were well attended and resultful, as were the eight smaller traffic conferences.

State officials gave the telephone men a closeup of situations over which the state has control. T. H. Thorsen, state tax commissioner, spoke on tax laws and advocated association effort in getting favorable tax laws for telephone companies. Frank Milholland, president of the state board of railroad commissioners also talked on commission activities.

J. C. Crowley, Jr., of the Minnesota association gave the convention a neighbor's viewpoint of their problems and operations, recommending that traffic matters be given lots of attention. Traffic got a commanding place on the program, with Miss Anne Barnes and some of the state's operators presenting a skit "Hokum Center; As It Was and As It Is."

W. J. Sorenson of the Otter Tail Power Co. addressed the convention on "Problems of Electric and Telephone Utilities," and made a good effort to get the two utilities on a basis of harmonious performance. There was a lively discussion following his talk and tribute was paid to the work of Mr. Sorenson's company in adjusting inductive interference cases. The outcome of this address was the establishment of a committee of five men, three from the telephone association and two from the state's power companies, to handle future differences between telephone and power companies. Such cases are to be acted upon first by the secretary of the association and if he can not settle them, the newly appointed committee is to swing into action.

Testing service now available to the state's smaller companies at a nominal cost was described by J. D. Taylor, division plant engineer of the Northwestern Bell Telephone Co. who spoke on "Some Rural Line Problems" in a very practical vein.

Commissioner Livdahl of the workmen's compensation bureau and A. J. Innis, area manager for the Northwestern Bell, who was representative for the association before the state legislature, spoke outlining their work for the industry at the concluding session of the convention. Thos. Phalen, secretary of the South Dakota association, also was a featured speaker at the windup of the meeting.

Kansas Warns Against Speculators

Manhattan, Kan.—At the twenty-seventh annual convention of the Kansas Independent Telephone Association more than 400 of the state's telephone men put their O. K. on a resolution deploring the advent of speculation in the telephone business and planning educational and protective action having the purpose of making properly issued telephone securities right with the public.

T. L. Youmans, Osawatomie, was re-elected president; Samuel Tucker, Pleasanton, first vice-president; Fred Scoresboy, Sterling, second vice-president; J. A. McDonald, La Harpe, third vice-president; V. E. Chaney, Kansas City, treasurer; Miss M. J. Hancock, Kansas City, assistant treasurer, and L. M. Kraege, Topeka, secretary.

A feature of the convention was the dedication of the new Manhattan exchange of the United Telephone Co., this model plant being given its coming-out party with impressive ceremony at which President Youmans and Harry Wareham, vice-president of the United, presided.

The convention's opening session heard Fred Coulson, Abilene, tell of the achievements of the telephone industry and point out the work the Independents now are doing. Public relations as developed by printed advertising and the work of the company employes was covered in two fine addresses, one by C. W. Motter, publicity director for the Lincoln T. and T., and the other by H. W. Davis, professor of English at Kansas State Agricultural College.

A number of practical plant addresses featured the program. Samuel Tucker told of the value of expert engineering advice to the small plant, relating his own company's experience. H. M. Cox of Diversified Investments spoke of the benefits of systematizing managers' work. Kansas is going at the job of developing telephone men with the aid of the state's educational institutions. R. A. Seaton, dean of engineering at Kansas State Agricultural College, told of the work his institution is doing, Professor R. G. Kloffler outlined the telephone short course to be taught at the school this spring, and J. T. Anderson, associate professor of economics at Kansas State, talked on the theory and practice of utility regulation.

Telephone Engineer

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L. T. Hussey, chairman of the Kansas Public Service Commission; C. L. Brown, president of the United Companies, and Charles Deering, secretary of the U. S. I. T. A., were among the other notables on the program.

Radio program service received interested consideration at the meeting. J. A. Gustafson, Fredonia, and B. H. Piepmeier, Kansas City, spoke on this topic.

An interesting series of first aid demonstrations were staged by United men during the convention.

Miss Anne Barnes spoke on "Co-ordination Between Commercial, Traffic and Plant Departments, and Ralph Van Trine, traffic superintendent of the United, directed a traffic conference, as the operators' part of the program.

One of the interesting and welcome spots in the convention was the issuance of "talk home" tickets by the United Telephone Co. to the convention delegates. These tickets entitled the conventioneers to free calls from Manhattan to any point in Kansas, Oklahoma, Missouri, Nebraska or Iowa during the meeting.

New Jersey to Have Own Bell Company

Newark, N. J.—A merger is planned of the New Jersey property of the New York Telephone Co. and the Delaware & Atlantic Telegraph & Telephone Co. It will mean a divorce of the New Jersey property from the New York Telephone Co.

The name of the new company has not been decided upon, but it is probable that it will be the New Jersey Bell Telephone Company. It will be a $100,000,000 corporation, the stock of which will be owned by the New York Telephone Company.

The personnel of the new company, it is understood, has not been decided upon definitely. However, the man mentioned most frequently as probably president of the company is George W. McRae, now general manager in New Jersey of the New York Telephone Company, who lives at Maplewood.

The method of merger, it is understood, will be for the D. & A. company, which operates in the southern part of New Jersey and was incorporated under the laws of this state, to purchase the holdings in this state of the New York Telephone Company, then issue against those holdings its own capital stock.

BRIDGING twisted pair to twisted pair, a practical application of the Kearney Solderless Service Connector.
FOR Telephone Lines in making party line taps, order Catalog No. 86. The tap can't slacken off. This connector is for No. 12 wire or smaller.
Unassembled Connector
ASK ABOUT KEARNEY CERTIFIED MALLEABLE SCREW TYPE ANCHORS
Kearney Guy Wire Serving Clips. Eliminate Serving End of Strand. Made of Aluminum, Copper, and Galvanized Iron.
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The Next Time You Come
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Room and Bath, 1 person —$3.50, $4, $4.50, $5
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Room and Bath, twin beds—$6, $7, $8
Under the personal supervision of ROBERT J. EITEL and MAX EITEL
Delaware Place at Rush St.
Just a few blocks from the Loop

Mission, Tex.—Rio Grande Valley Telephone Co. to spend $100,000 on new exchange building and equipment.

Ohio Meeting Planned as Association's Best

Columbus, O.—Buckeye Independents are confident that the state association's annual meeting this year to be held at Columbus April 27-29 will be one of the best attended in the organization's history, and that every telephone man and woman who comes to the meeting will find their time well invested because particular attention has been paid to the preparation of the program.

T. P. Sylvan Made New York Director

New York City—The annual meeting of stockholders of the New York Telephone Company resulted in one change made in the personnel of the Board, Tage P. Sylvan, vice-president, replacing H. F. Thurber, who recently retired from active telephone work after thirty-seven years of service.

Loganville, Wis.—Charles Wheeler has bought Loganville Telephone Exchange from his brother Fred.

Winona, Ind.—Winona Telephone Co. has bought exchanges at Medaryville, Kentland, Brook and Earl Park.

Redgranite, Wis.—Wisconsin Telephone Co. purchases local telephone company.

Cass City, Mich.—Thomas R. Condon, Chicago, has bought Cass City Telephone Co.

Albert Lea, Minn.—Tri-State to build new exchange building here.

Whiteburg, Ky.—Cumberland T. & B. T. Co. has bought Whitesburg Telephone Co.

St. Paul, Minn.—Continental Telephone Co., buys plant of Tucker Telephone Co. at Cave City, Ky.

Bushnell, Ill.—Mann Telephone Co. buys Vermont Telephone Co.

Circleville, O.—Theodore Gary & Co. have bought majority of common stock of Citizens Telephone Co.

Franklin, Ind.—Franklin Telephone Co. bought by P. F. Goodrich of Indianapolis, and associates.

TELEPHONE ENGINEER

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Removable Burner Block. Orifice cannot be enlarged
Patented Furnace Type Burner, Greater Heat and Continuous Operation
Easily Removable Needle Cleans Burner Orifice Every Time Valve is Opened or Closed
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Filler Plug on Top Easily Filled, No Chance for Dirt to Enter
Angle Handle Restful and Easy to Hold
Handle Support Does Not Extend Through Tank
Pump Has Double Check Valve, Second Held in Place by Clevis
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Three Thicknesses of Steel Where Greatest Wear Takes Place

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DREADNAUGHT

This new steel torch combines all the advantages of the time-tried older Dreadnaughts with a number of improvements. Built for heavier work, to give a bigger, hotter flame. New burner cleans itself automatically. All joints brazed with hard brass spelter solder; every torch tested. Can be used in all kinds of weather. A better "service with safety" torch that has been adopted by many of the largest public utility companies. Let us tell you more about the new Dreadnaught No. 41.

P. WALL MFG. SUPPLY CO.

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Since 1864

Kellogg Publishes Big New Catalog

Chicago, Ill.—Kellogg Switchboard and Supply Co. has issued a new catalog covering its complete array of equipment for magneto exchanges, as well as construction equipment. The book is comprehensive and put together in a way that makes it an exceedingly valuable and practical purchasing guide. The new catalog is designated as No. 8-M and will be sent on request to any interested telephone manager who has not received a copy.

Hahira, Ga.—Consolidated Telephone Co., Moultrie, has bought local system.

Rochester, N. Y.—Ernest E. Chappell, who has been director of station WFBL at Syracuse for more than two years, has resigned to accept appointment as manager of station WHAM, owned and operated by the Stromberg-Carlson Telephone Mfg. Co.

Lenoir, N. C.—Southern Bell has bought local telephone company.

Olathe, Kan.—Southwestern Bell has purchased local telephone company from Mrs. J. C. Nichols, Kansas City.

Casey, Ill.—Casey Telephone Co. has bought Neoga plant.

Bell's Annual Plant Additions Wou'd Pay for New Panama

New York City—The parent company and the associated companies of the Bell System will expend during the present year a total of $395,000,000 for gross plant additions. This sum would pay the entire construction cost of the Panama Canal, exclusive of expenditures for military fortifications, and leave a sufficient balance to have paid the original agreed price of the Louisiana Purchase.

The total includes the following expenditures: Land and buildings, $33,000,000; central office equipment, $105,000,000; station equipment, $80,000,000; exchange lines, $110,000,000;

Announcing— ***the Highway Earth Boring Machine***

Bores the Hole--Sets the Pole

A pole in the ground every five and one-half minutes is the record recently made on new line construction —under actual operating conditions. A three-man crew with the Highway Earth Boring Machine and Pole Setter bores the holes, sets the poles and moves from position to position all in this remarkable time. A saving of 75% of the time required for the same work by any other method.

The machine mounted on a Fordson or International Harvester tractor, equipped with crawlers, negotiates steep grades and swamps and easily reaches ninety percent of all locations.

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Capacity 1034

The Location is Unique in the Heart of the Automobile District, with Subway, Elevated Street Cars, Busses---all at door.

RATES

Room, Private Toilet - - -	$2.50
Single Room with Bath - -	3.50
Double Room with Bath - -	5.00

M. P. MURTHA, General Manager *Ample Parking Space*

Consider Merger and Buying Problems at Texas Meeting

Fort Worth, Tex.—Texas Independent telephone men met here in their twenty-second annual convention and walked right into an expert clinic on the various problems accompanying the merger and buying operations that have been taking place, or in progress, in the state.

The Lone Star telephone men exhibited great satisfaction with the helpful manner in which the last year's administration has been running things and re-elected all officers. The re-elected officers:

President, R. B. Still, Tyler, general manager, Gulf States Telephone Co.

Vice-president: F. W. Greber, Brownwood, vice-president, West Texas Telephone Co.; J. B. Earle, Waco, president, Texas Long Distance Telephone Co., and John Y. Rust, San Angelo, president, San Angelo Telephone Co.

Secretary, L. S. Gardner, Waco, auditor, Texas Long Distance Telephone Co.

Treasurer, D. J. Johnson, Santa Anna, president, Santa Anna Telephone Co.

President Still in his annual address saw in correctly made and sound mergers, operated by experienced telephone men, a betterment of the Independent situation and a decided improvement in the financing operations. He counseled Independent men who have properties to stay in the business because it is one of the safest and best and growing in importance. He pointed out the personal difficulties that would confront the seller of a property in finding a safe place to invest his funds and in getting located in another satisfactory situation. He cited the Independent standing of 750,000 telephones to the Southwestern Bell's 1,250,000 in the Southwestern's territory as indicative of the Independent standing. He spoke of the development in toll operating methods and changes in rates that work for the good of all concerned, mentioning the co-operation between the Bell and the Independents in improvement of toll business. He said, "Our plants are second to none and capable of rendering the best service" in commenting on the condition of the majority of the Texas Independent plants.

President Still urged his hearers to work with the national Independent association in getting the right kind of an Interstate Commerce Commission order. He mentioned the possibility of a ruling that would mean a calamity to the industry in impressing upon the convention the necessity of action in this matter.

Plant, public relations and legislative activities of the Texas telephone companies were touched upon in the presidential remarks.

"Optimism of Faith and Devotion of Service" was the subject upon which Lon A. Smith, a member of the Texas Railroad Commission, spoke in an inspiring vein.

The creosoted pole came in for an interesting explanation of its production and service merits in the talk made by D. E. Roach, sales manager of the Texas Creosoting Company. Mr. Roach spoke on "Some Reasons for the Increasing Popularity of Creosoted Pine Poles" and illustrated his lecture with lantern slides.

Radio Redistribution

Distribution of radio programs through telephone company facilities was discussed by Harry N. Faris, United Trust Co., L. W. Scherer and B. H. Piepmier, Diversified Investments, Inc. The technical and commercial phases of this growing factor in the telephone business were treated at length, and a number of cases were reported of considerable additional income to the telephone companies as a result of this service.

"Don't permit a consolidation unless it is good for the subscriber," said Judge S. A. Lindsey, Tyler, during his address on "Telephone Consolidations and Their Effect." A thoughtful and valuable address on the various aspects of consolidations and financing was made by G. W. Robinson, St. Paul, president of the Tri-State. He analyzed some promoters, circulars and showed the glaring errors and dangers that were plainly evident to one who knew all the facts of the situations under consideration. He mentioned the item of depreciation as one frequently neglected in the glowing circulars put out on the refinancing of some telephone properties by the "sharp-shooters."

Other angles of the financial side of the telephone business were shown by E. C. Blomeyer, chairman of the board, Diversified Investments, Inc., in his talk on "Telephone Financing." Mr. Blomeyer showed the marked differences between the telephone industry and other utilities, in the restrictions of markets and the possibilities of effecting economies by merging. He also talked of cases of telephone men selling good properties and then being disappointed in not being able to buy other telephone properties nearly as good as the ones they had sold.

Two headliners on subjects that are near to the heart and purse of the telephone industry were among the features on the program. R. W. Hedrick, Jefferson City, Mo., spoke on "Practical Telephone Problems" and V. E. Chaney of Kansas City discussed the depreciation order from an accounting viewpoint. The Chaney remarks were followed by a lively round-table session. A safety first address and demonstration was put on by

Conservative Telephone Financing

TELEPHONE Bond Issues originated by reliable houses are created in accordance with approved procedure. Such bonds represent reliable investments. The interests of the borrowing company, the investor and the banker are mutually protected.

Send for article, "How Telephone Financiers Lay Their Foundations." Mailed free upon request without obligation.

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Cord circuits equipped for party line ringing

Mahogany finish.

Excellent condition.

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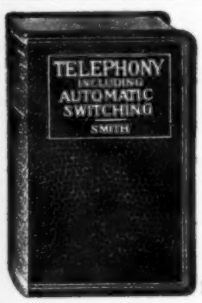

A Great Practical Book *for the* Practical Telephone Man

TELEPHONY

including

AUTOMATIC SWITCHING

By Arthur Bessey Smith

The following brief outline shows the scope of this work: The magneto receiver, local and common batteries, instruments, private lines and exchange, multiple and "feature" switchboards, automatic switching and telephone instruments, 100, 1000 and 10,000 line exchange, party lines, multi-office exchange, large city systems, private automatic exchange, power plants, testing and adjusting, toll, phantom circuit, loading of lines, measured service, index.

The price of TELEPHONY, including AUTOMATIC SWITCHING, is $2.50

TELEPHONE ENGINEER
225 N. Michigan Ave. Chicago, Illinois

T. W. TURNER—Cable Splicing and Repair Work. Jobs done by Hour or Contract. Satisfaction Guaranteed.

Deerwood, Minnesota

C. J. Rutland, R. M. Moore and Jack Conder.

As one of its concluding acts the convention resolved to keep a vigilant watch over the issuance of telephone promotional securities and warn the public against investment in any suspicious securities.

During the convention a well attended traffic conference was conducted under the supervision of Sam H. Shutt, Waco, general superintendent of the Texas Long Distance Telephone Company. Miss Anne Barnes and many of the state's leading operators, as well as several of the leading executives of the state's telephone companies, spoke at the conference.

Demonstrate "Ansaphone" at Terre Haute

Terre Haute, Ind.—A demonstration of the Ansaphone, a device for automatic answering of a telephone and the delivery of the message to the telephone's subscriber, was staged here by J. L. Collins of Dallas before Hart L. Farwell, president of the Citizen's Telephone Company.

How to Put Across Bill's Story

Bellevue, O.—An interesting and convincing explanation of the telephone bill is contained in the Northern Ohio Telephone Company's house organ, the *News*. This explanation says:

"If one of our subscribers were to demand an itemized bill for a month's telephone service in place of the one he usually receives each month, the bill for a two-dollar a month telephone would read very much like the following:

To maintenance of equipment, wires and plant	$0.28½
To reserve for accrued depreciation	.19
To operators' wages and traffic expense	.49½
To collection and other commercial expense	.09
To general office expense and insurance	.20½
To taxes	.18½
To office rentals and interest	.02
To interest and dividends at 6%	.52
To surplus	.01
Total	$2.00

"Few subscribers know that there is over $130,000 invested in plant and equipment back of each telephone we operate and that the interest and dividends alone at 6% on this investment amounts to $7.80 per year.

Beg Your Pardon; Only 9/10 Wrong

The new Stromberg-Carlson catalog, mentioned in the March issue of TELEPHONE ENGINEER as being of 26 pages, actually runs 260 pages. The mistake was obviously a typographical error that was quickly recognized as such by those who know the complete manner in which the Stromberg-Carlson organization puts out its catalogs.

Easy to See Why the UNIQUE FURNACE is preferred

PATENTED ARRANGEMENT FOR DISLODGING COIL WITHOUT TEARING DOWN FURNACE
PATENTED SEAMLESS TUBING COIL GENERATOR
IMPROVED ONE PIECE BURNER
HAND HOLD FOR CLEANER ONE TURN CLEANS ORIFICE
AUTOMATIC ORIFICE CLEANER
16 GUAGE STEEL TANK WELDED BOTTOM
AUTOMATIC PUMP INSIDE TANK

Many of the foremost Bell and Independent companies have standardized the Unique Furnace. It melts 50 lbs. of lead in 10 minutes. An automatic orifice cleaner assures continuously efficient operation. It's sturdy and simple.

"UNINTERRUPTED SERVICE"—the result of a "UNIQUE DESIGN and BETTER CONSTRUCTION."

Literature ready—BLOW TORCH and Furnace.

UNIQUE MFG. CO.
113 N. Des Plaines St. Chicago

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Everstick

Approved by Large Operating Companies For the Following Strains

6" 2-way	2,200 lbs.
6" 4-way	6,000 lbs.
8" 2-way	6,000 lbs.
8" 4-way	10,000 lbs.
10" 4-way	16,000 lbs.

Write for Details

Everstick Anchor Co.
ST. LOUIS, MO.

Make Your Directory a Source of Income
Write for Particulars
J. H. WELKER
McKinley Block, Canton, O.
Telephone 8009
DIRECTORY ADVERTISING EXCLUSIVELY

Big Spring, Tex.—P. L. Fletcher, manager of the Coahoma and Westbrook telephone exchange, plans building a line to the new oil town, Ross City.

Oklahoma Holds Greatest Utility Meeting—Scherer Heads Phone Men

Oklahoma City, Okla.—Breaking all records for attendance at Oklahoma utility conventions, 825 Oklahomans met at the ninth annual gathering of the Oklahoma Utilities Association held here March 8-10.

Each forenoon was devoted to a general program. During the afternoons the group meetings of the various sections were held.

L. W. Scherer, Yale, was elected first vice-president of the association to head the telephone division. Other telephone division officers elected were: John P. Youmans, Poteau, secretary, and H. W. Hubenthal, Oklahoma City, engineer.

An outline of the work of the telephone division was given in the address of Manager E. F. McKay of the association. Other addresses on various phases of interest to the telephone division made up an exceedingly practical program. In his address Mr. McKay said:

"In numerous matters telephone companies have been represented by the association before the state board of equalization, always with definite results of advantage to the companies concerned. The association is represented at all telephone hearings before the corporation commission and almost invariably is able to render valuable service to the companies concerned.

"The telephone division numerically is the largest division in the association, and through this division the association has a direct and continuous contact with every section of the state.

"In 1926, 12 district conferences, or group meetings, were held by the telephone division in as many sections of the state. The number of district meetings was increased over that of former years in the hope that through the greater number of meetings a greater total attendance could be secured, and such was the result, the total attendance for 1926 exceeding that of group meetings for 1925 by about 25 per cent.

"These meetings are valuable in the spirit of good feeling developed, as well as for the information of a practical character which is afforded those in attendance, many of whom find it impossible to be present at the annual state convention.

"Telephony company managers almost invariably visit the association offices when in Oklahoma City, usually with some problem in connection with which they are in need of advice or help.

"During the year, the service of the telephone division has extended to the making of inventories, accounting and traffic studies and the preparation of rate applications for numerous member companies, the services performed by the association in some of the cases saving the companies concerned large sums of money. In many cases, as result of office conferences and conferences between telephone companies, the corporation commission and the association representatives, threatened controversies are disposed of without recourse to formal procedure.

"The association's telephone engineer often is called upon to assist in the preparation of annual reports to the corporation commission, giving the company members concerned the benefit of experience and advice not otherwise available.

"At this time a tentative set of standard rules and regulations for telephone companies is under consideration by the telephone division with the hope that certain diverse practices may be made uniform for the convenience and advantage of the industry. Representatives of the corporation commission are being consulted constantly, and it is believed that a standard code, which will clarify the situation as to many operating practices, satisfactory to the industry and the commission alike, may be worked out.

"Considerable attention has been given by telephone company members of the association to the development of radio rebroadcasting."

Sturgis, Mich.—United Telephone Co., Chicago, has bought Southern Michigan Telephone Co. Purchase price reported as $919,000.

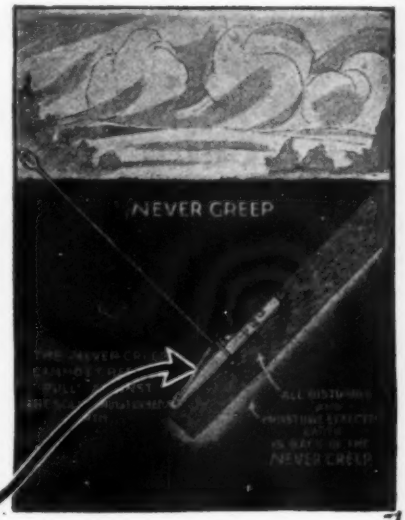
Logansport, Ind.—Associated Telephone Co., buying plants at Wolcott, Goodland, North Judson, Ayr, St. Joseph, Bremen and Tyner, all in Indiana.

Greenville, O.—Merger of telephone companies in Darke and Shelby counties has been completed under name of Ohio Telephone Service Co.

Galena, Kan.—General Telephone Co., Chicago, has bought Galena Home Telephone Co.

London, Eng.—During 1926 119,092 new telephones were installed in Great Britain and northern Ireland.

London, Eng.—Official figures show there were 1,510,775 telephones in Great Britain and northern Ireland up to December 31, 1926.



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The more you look into anchor construction and performance the more you realize that undisturbed earth to pull against is a vital consideration. Tamping very seldom suffices to give the holding condition an anchor needs. Moisture seeps down to the holding plate of the anchor and collects there with a great sacrifice of the anchor's rigidity. You know how these factors ruin holding power, so play safe by standardizing the NEVER-CREEP and get away from the perils that are bound to come when the earth is disturbed during anchor installation.

The NEVER-CREEP alone has the Thimbleye rod.

Foremost wire companies prefer the NEVER-CREEP. So will you when you learn its complete story. Write us for details.

Chance Company
Centralia, Mo.

Made in Canada by
N. SLATER CO., INC.
Hamilton, Ont.

Television Realityas New York Sees and Hears Washington

New York City—Television received its first formal debut on April 7 when Walter S. Gifford, Bell president, and F. B. Jewett, who is a Bell vice-president as well as president of Bell Telephone Laboratories, sat in New York and talked with, and saw, Secretary Hoover at Washington.

At this historic demonstration there were many members of the Bell staff who had worked to bring into reality this achievement, which but a few years ago was generally considered a fanciful dream, other notables and a group of newspaper men. The television installation showed the transmitted view of Secretary Hoover talking, only at the New York end of the demonstration.

In his remarks at the demonstration President Gifford said:

"The principles underlying television, which are related to the principles involved in electrical transmission of speech, have been known for a long time, but today we shall demonstrate its successful achievement. The elaborateness of the equipment required by the very nature of the undertaking precludes any present possibility of television being available in homes and offices generally. What its practical use may be I shall leave to your imagination. I am confident, however, that in many ways and in due time it will be found to add substantially to human comfort and happiness.

"It is our constant aim to furnish this country with the most complete telephone service possible. In connection with that aim, we endeavor to develop all forms of communication that might be supplemental to the telephone. With that in view, we shall continue our work on television which, although not directly a part of telephone communication, is closely allied to it."

Relative to the technical phases of the achievement, Mr. Jewett remarked at the demonstration:

"When some years ago it began to be evident that scientific knowledge was advancing to the point where television was shortly to be within the realm of the possible, we took up seriously a study of the problems involved. Under the supervision of Dr. Ives research and development on the various elements of terminal equipment and connecting channels was undertaken. As a result of this co-ordinated work we are today in position to view scenes and actions at a distance and to employ in their transmission either telephone wires or radio waves. To accomplish this result much fundamental research work was required, many new things had to be devised and many old principles were applied under the guidance of recently acquired scientific knowledge. Principal in all this has been the knowledge obtained during the past few years in the research and development which has made possible transcontinental and transoceanic telephony and telephotography.

"The demonstrations show not merely laboratory achievements over short distances within the walls of a building, but also transmission over very long distances. To show that television is not confined to any single medium of transmission we have arranged that you shall witness television both over wires such as are employed in long distance telephony and by radio. From Washington, D. C., you will have transmission wholly by wires, while from the laboratories' great radio experimental station at Whippany, N. J., you will have simultaneous sight and sound by radio. That television from either place is not inferior to that obtained within the laboratory itself you will have opportunity to prove with the apparatus which we have assembled at the two ends of this auditorium.

"While research and development work for the perfection of television will go on for years, enough has already been accomplished to indicate that it is likely to have a real place in the world's work of distant communication. Today we are relatively farther along in our work on television than we were on transoceanic telephony in 1915 when the American Telephone & Telegraph Company conducted the first successful test from Washington to Paris and Honolulu.

"In attempting to form a picture as to the future development of television there is one inherent limitation of any television method which we should keep clearly in mind, however. This is the fact that it requires the use of a large group of frequencies and the transmission of these frequencies requires as great capacity as a considerable number of ordinary telephone circuits. It is this fact which puts television economically in a class quite different from that of ordinary telephony or telegraphy."

Television Outlined

Concerning the technicalities of television the Bell Telephone Laboratories state:

"In the electrical transmission of pictures the transmitter is responsive to light waves. Its sensitive element is a photo-electric cell; and the current from it varies in intensity according to the light to which it is exposed. When this cell is exposed to light emanating from successive small areas of a picture there results a current with variations in intensity corresponding, and in similar order, to the variations in light and shade of the picture. This is accomplished by using a film-transparency of the picture, passing through it onto the photo-electric cell a narrow beam of light, and moving the film uniformly and continuously so that the cell responds successively to the light from all the elemental areas of the picture.

"Reception in telephony is an operation of translating current variations into sound waves. In a telephone receiver a diaphragm is vibrated by the electromagnetic action of the varying current and in its movement of the adjacent air it acts as a source of sound to emit waves similar to those which impinged upon the distant transmitter.

For the reception of pictures, current variations are translated into variations of light intensity. This might be accomplished by an electro-optical action of the current, giving rise to light waves similar in intensity to those which acted on the distant photoelectric cell. In the electrical transmission of pictures, however, translation is obtained most conveniently by varying the portion of light from a constant source which is allowed to fall upon a sensitized film. An electromagnetic action of the varying current, therefore, is employed to operate a "light valve" through which passes a narrow beam of light.

"The valve varies the size of the beam in exact accordance with the current variations; and thus the sensitized film is exposed to variations in light intensity similar to those in the picture which is being transmitted. The film is moved across the beam continuously and uniformly so that its successive areas are exposed in the same order, and for the same small intervals of time, as the corresponding elemental areas of the original picture were exposed to the beam which actuates the photoelectric cell of the transmitter. The necessary synchronization of the mechanisms, which drive the negative at the transmitting station and the sensitized film at the receiving station, is accomplished by electrical means. For this purpose there are employed other currents, or other waves in the case of radio, which pass between the two stations and by their electromagnetic

actions control the driving mechanisms and maintain them in step with each other.

"In television a series of essentially instantaneous views of a scene with action must be transmitted and reproduced at a rate, fifteen or more a second, such that an observer will detect no discontinuity of action. In broad principles the method is similar to that of the electrical transmission of pictures. A photoelectric cell, acting as an 'eye,' rapidly scans the scene, viewing in orderly succession each detail of it, and transmitting to the distant station a varying current, the variations of which correspond to the differences in light and shade of the successive details.

"At the receiving station this current produces at each instant a spot of light of a brightness corresponding to that of the detail of the scene which the photoelectric eye was observing at the moment it originated that particular amount of current. At each instant the position of this spot of light is also caused to correspond to that of the detail of the scene. The entire scene, in successive details, is thus reproduced for an observer. The complete process of reproducing in proper order the light details of the scene occupies less than a fifteenth of a second. It is then automatically repeated and thus each detail is instantaneously viewed by the observer fifteen times a second. Be cause of physiological and psychological phenomena, however, the observer is unconscious of the series of details and apprehends the scene as a whole with continuous action.

Apparatus for Television and Its Operation

"Like the familiar transmitter-microphone and receiver of telephony, the apparatus of television is terminal equipment, and any suitably high-grade medium, whether wire or radio, may be used for the intervening transmission. In its present form the sending apparatus is adapted to obtaining for one participant in a telephone conversation a continuous view of the face of the other participant. Such a view the receiving apparatus re-creates on a picture plane about two by two and one-half inches; or, with an alternative form of equipment, on a plane about two feet square for observation by more than a single person.

"At the sending station there is, in addition to the usual telephone deskstand, the special equipment for transmission in television. There is, first of all, a gigantic photoelectric eye, which placidly views the scene before it but receives no appreciable stimulus unless the scene is strongly illuminated. The second portion of the equipment includes a high-powered light. The beams from this are not allowed to flood the scene and dazzle the actor. They are reduced to a narrow beam illuminating on the face of the actor a spot not more than a quarter of an inch square. This beam, guided by the so-called "scanning disc," never pauses, and sweeps the entire scene in less than a fifteenth of a second.

"As each detail is illuminated the photoelectric cell instantly responds, initiating a current proportional to the light reflected to it, and hence proportional to the light and shade of the particular detail. As the beam of light swings across the scene, working its way from top to bottom, the current from the cell varies correspondingly. So swiftly does the beam sweep the scene that the current variations are wide and rapid—sometimes corresponding to a change from a maximum current to a minimum and back to a maximum in a twenty-thousandth of a second. These variations, the so-called alternating-current components, are transmitted to the receiving equipment, where they are effective in reproducing the scene.

The beam, which assists the photoelectric eye to scan the scene before it, is actually a succession of beams. In front of the source of light revolves a disc, the "scanning disc," in which is a series of holes through which darts of light escape to illuminate, successively, narrow, horizontal strips of the scene. This disc is driven by a combination of two electric motors.

Identical motors operate at the receiving station to insure to the flashes of light the orderly succession necessary to re-create the image. Exact synchronism at the two ends of the system is accomplished by using at each two "synchronous" alternating-current motors. At each end one motor, the main one, operates at a frequency with which complete images of the scene can be formed. To prevent this motor from "hunting," that is, from small variations in speed alternately above and then below that corresponding to eighteen cycles per second, a second and smaller motor assists the drive. This synchronous motor, operated at 2,000 cycles in the range of telephonic rather than power frequencies, insures that the rotating mechanisms at the two ends of the system shall not be out of step with each other by more than the amount represented by half of one of the small holes in the disc.

"At the receiving station there is, first of all, a source of light which responds with a brilliancy corresponding to the current which is received from the transmitting station. The source is a "neon tube," a glass tube filled with rarefied neon gas and provided with electrodes; when a high potential is applied to the electrodes there takes place a glow discharge, the brilliancy of which is exactly proportional to the potential.

The Telephone Business for Telephone Men

WE firmly believe in the Protective Measures advocated by the United States Independent Telephone Association and the various State Associations, with respect to Telephone Financing.

***Along these conservative lines only*—we are interested in assisting Telephone Companies in connection with Mergers and Refinancing.**

Our advisory-engineering, report and valuation service is directed by Mr. Charles W. McKay, a Consulting Telephone Engineer of over twenty years' experience.

We invite correspondence with respect to your own individual problems.

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